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CAPTAIN BOYTON AT PARIS.

It is now nearly four years since Captain Boyton first attracted the attention of the public by his feat of swimming across the Strait of Dover, between Dover and Boulogne, in an apparatus which, if not of his own invention, has, at least, been brought by him to the highest stage of perfection.

This apparatus is an India rubber suit, consisting of pantaloons and a blouse with a hood, united to each other, and fastened around the body by an elastic belt. The legs of the pantaloons terminate in boots, and the ends of the sleeves of the blouse are fitted tightly around the wrists. The edges of the hood encircle the face very closely, leaving the face itself free. In the interior of the clothing, both in the upper and lower portions, air pockets have been contrived which, by means of exterior tubes long enough to reach the mouth, may be inflated at pleasure. This operation accomplished, the person inclosed in the apparatus acquires on water the lightness of cork; and, like the latter, cannot be submerged. He can abandon himself with confidence to the treacherous element, from which he has nothing to fear, and upon which he can direct his course with the greatest ease by means of the oar shown in our engraving in the hands of Captain Boyton.

It is by means of the apparatus just described that the Captain has been able to cross the Strait of Dover two or three times, and the Strait of Gibraltar once, speaking now only of such of his feats as have caused a sensation. For some time he has been contemplating a trip to Paris, but never carried it into effect. At length, however, this projected voyage has been accomplished, and it is doubtless to the Universal Exhibition that we owe it. The young American arrived on the 6th of August, on board a steam yacht built for him at Nantes, and upon which he has bestowed his own name. This vessel, very comfortably furnished, contains six berths, not including those of the crew, numbering five men, and among which are two negro cabin-boys brought by the Captain from California. The yacht, which is propelled by an engine of twenty horse power might, if occasion demanded, carry a hundred persons. Captain Boyton having cast anchor in the waters of the Exhibition, near the gates of commerce, arrived at Paris with the intention of giving himself up to his swimming exercises on the Seine. In fact, scarcely had he obtained the necessary permission from the proper authorities, than he repaired by railway to Nogent-sur-Seine, from whence, having taken to the water, he was to descend the river to Paris.

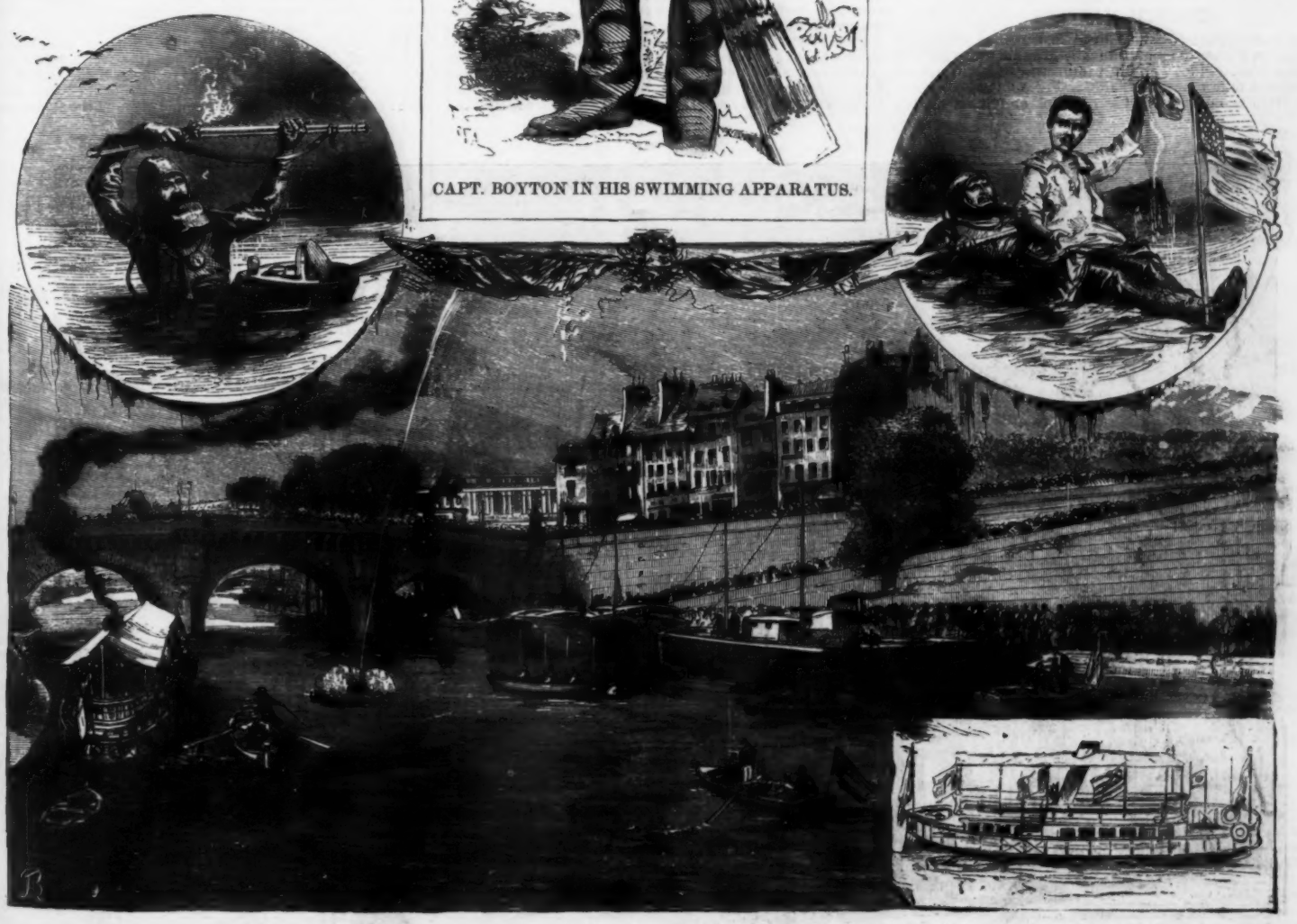
CAPT. BOYTON IN HIS SWIMMING APPARATUS.

Starting at four o'clock in the afternoon of August 12, the bold swimmer, in less than seventy-two hours, accomplished the 120 miles distance which separates Nogent from Paris by water, and arrived at Paris precisely at the hour that he had indicated in his dispatches.

The yacht *Paul Boyton*, of which we have spoken, had been placed at the disposal of the press to go to meet the Captain, who was encountered at about two-thirds of a mile below the confluence of the Marne and Seine.

The moment Boyton was sighted, escorted by a real flotilla of small craft, decorated with flags of all colors, loud cheers arose both from the yacht and the shores. The intrepid swimmer responded to these acclamations; then, stopping for a moment, he hoisted at his feet the American flag, placing the staff in a socket fixed to one of his boots for that purpose. This done, he resumed his journey, plowing through the waters with great rapidity by means of his oar.

An immense assemblage crowded both bridges and wharves; and, as to the boats that accompanied the bold swimmer, their number was such that they more than once impeded him in his progress. At the Pont de Bercy, the Captain found himself all at once squeezed up between a carelessly steered ferry-boat and an arch of the bridge, and had it not been for his very skillful maneuvers his head would have been dashed against the stones. Near the sluice of the Pont-Neuf he set off several rockets, smoked a cigar, and fired a gun several times. Arrived near the Exhibition, he caused one of the two negro cabin-boys to come down over the side of the yacht, placed him astride his stomach, and thus continued to swim, while the little darky unfurled the American flag. The wharf at length having been reached, an incident took place which caused some little merriment. Just as the passengers were about landing, an agent jumped on the gang-plank and demanded the tickets. Now every one had already paid his entrance



THE PARIS EXHIBITION.—THE ARRIVAL OF CAPT. BOYTON AT THE PONT-NEUF AFTER HIS DESCENT OF THE SEINE BY SWIMMING.

1. Capt. Boyton Firing a Gun.—2. Capt. Boyton Carrying one of his Cabin Boys while Swimming.—3. The Captain Discharging a Rocket near the Pont-Neuf: View of the Bridge, Wharves, and River.—4. The Yacht *Paul Boyton*.

money at the time the yacht departed on its excursion. Nevertheless the dispute was about waxing bitter when a friend of the Captain stepped up to the ticket agent, and said to him: "It is true, Captain Boyton has forgotten to pay his entrance to the Exposition to-day, but the reason is that he came by a route where he found no wicket. He has requested me to give you this ticket, hoping that this will settle the matter."

Meanwhile, the Captain, who had changed his costume, appeared on the scene, saluted the crowd and delivered the following short speech:

"I regret, gentlemen, that I cannot speak French. I have had, in the voyage that I have just made, much to contend against in wind and wave; but here I am, however, and on hearing your cheers, I doubly regret not being able to speak French well enough to thank you as I should like to."

The party then repaired to the Anglo-American restaurant, where a lunch had been prepared.

Captain Boyton is a man about thirty years of age, whose face expresses energy and resolution. He has been decorated four times, received fifteen medals, and, it is said, has lately been the recipient of a sword. But why a *sword?*

FRENCH HATTERS.

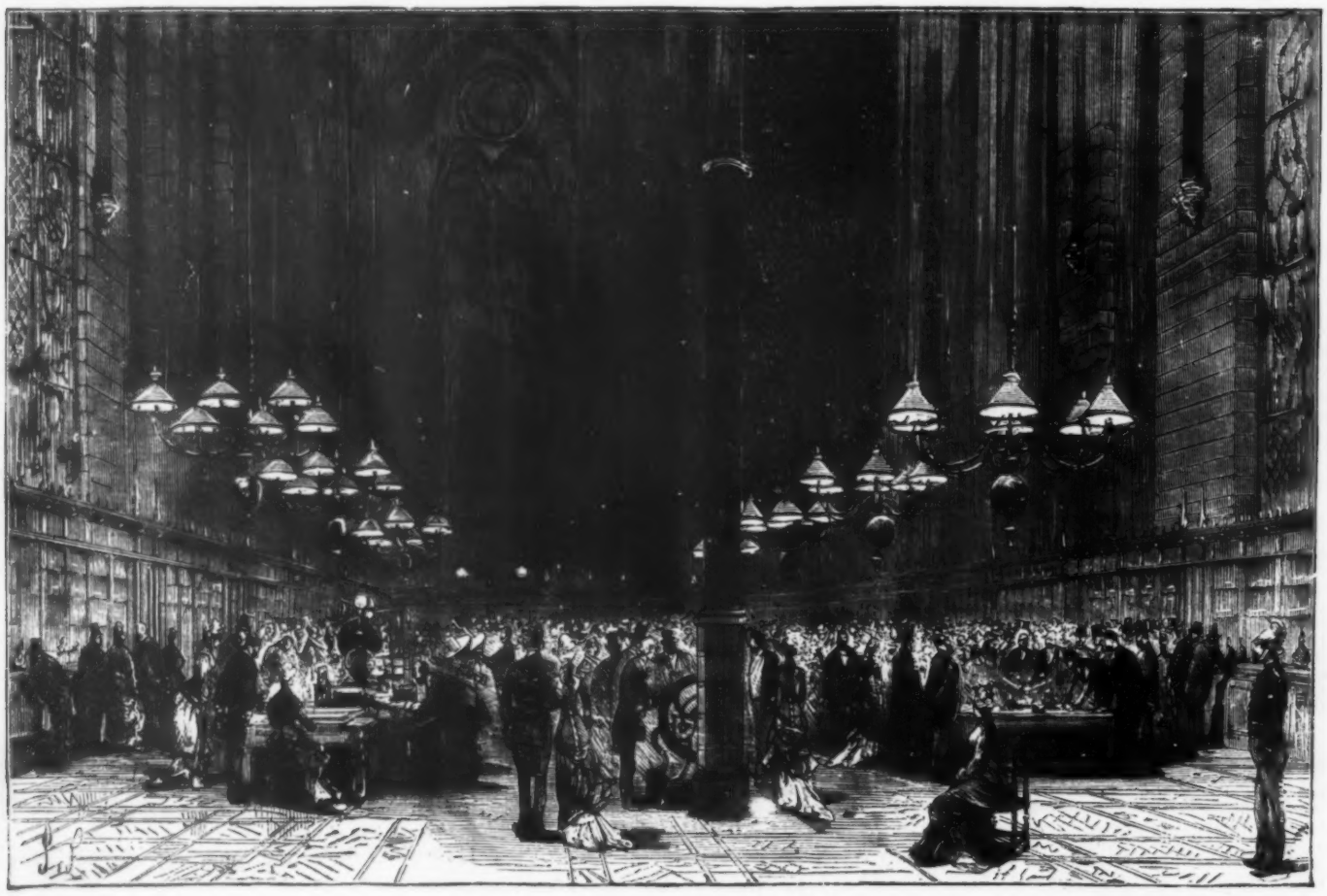
The manufacture of felt and silk hats and of straw hats and caps in France amounts annually in value to 120,000,000 francs at least. Since 1867 the manufacture of felt hats alone may be said to have made progress. For wool hats the price varies from 1s. 3d. to 4s. and 5s.; for fur or felt hats, from 2s. 6d. to 30s. The silk hat is not much worn, except in the large cities. The constantly increasing use of the felt hat has made the silk hat manufacture lose a part of its importance. The mechanical hat known as "Gibus" (a sort of spring hat) is manufactured only in Paris. (*Sic.*) A quantity of these hats are made for exportation. In Paris the workman engaged in the manufacture of silk and fancy hats earns about 7 francs (5s. 10d.) a day; the pay of workmen who make a specialty of trimming varies from 3 francs to 3 francs 50 centimes (2s. 6d. to 2s. 11d.) a day. In felt hat making, which is carried on mostly in the country, the average daily pay of the workman is about 5 francs (4s. 2d.); that of females employed in the business varies from 2 francs 25 centimes to 2 francs 50 centimes (1s. 10d. to 2s. 1d.). The raw materials used in the manufacture of straw hats are Panama straw, the fiber of the palm tree, which comes from America, braids of hair and of fancy silk, and braids of straw matted or meshed which come from Italy, England, Switzerland, and Belgium. Palm and Panama hats are made in the Departments of Meurthe-et-Moselle and the Vosges; the braiding of straw grown in France is done in the Departments of L'Isère and Tarn-et-Garonne. Fine hats, ladies' hats especially, are made in some of the provincial cities, but chiefly in Paris. Country workmen who also devote themselves to agricultural pursuits can earn from 1 franc to 3 francs (10d. to 2s. 6d.) a day, according to their skill. As to those who make a specialty of straw work in Paris and some of the provincial cities, their daily earning varies for women from 2 francs to 2 francs 50 centimes (1s. 8d. to 2s. 1d.), and for men from 5 to 6 francs (4s. 2d. to 5s.).—*French "Hatter."*

THE PARIS EXHIBITION—TERRA COTTA VASES—BY WATCOMBE & CO., ENGLAND.

THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

On the 22d of August the Seventh Congress of the French Association for the Advancement of the Sciences began its sessions by an inaugural meeting in the Sorbonne, at Paris. Long before the hour designated the court of the Sorbonne was filled with an animated crowd, composed chiefly of the most distinguished men whom science counts as her devotees, and among these were a large number of celebrities from various foreign countries. The President, M. Frémy, delivered the opening address, selecting for his subject "Soda and Steel in 1878." After this the members of the Congress repaired to the Lyceum Saint-Louis, where the fifteen sections into which the Association is divided found suitable halls provided for their deliberations.

The papers read in the different sections were of the highest scientific interest, and of these we hope to present abstracts to our readers at no distant date. Visits to scientific and industrial establishments attracted a great number of the members desirous of a closer study of applied science. The observatories of Paris, Montsouris, and Meudon, the sewers of Paris, the School of Agriculture of Grignon, the powder mills of Sevran, the aniline works of Poirrier, the gas factory of Villette, etc., were also visited in succession, and the savants brought away copious notes of their observations, which will undoubtedly bear their fruit in the future. One of the most brilliant features of the occasion, and one which contributed largely to the *éclat* of this Seventh Session, was the scientific soirée given at the Conserva-



SOIREE OF THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE FACADE OF THE SWISS SECTION.

toire des Arts and Metiers, on the evening of August 27th. On this occasion the Conservatoire threw open its galleries and gardens to the members of the Association and invited guests. The society which assembled was composed largely of men of the highest scientific attainments, who were received at the foot of the grand stairway by General Morin and MM. Frémy and Fresca. The vast halls were brilliant with thousands of gas jets, and eighteen electric lamps diffused a light brighter than that of day over the extensive parks of the Conservatoire. In the grand amphitheater the guests were entertained by M. Cornu, who exhibited numerous magnified objects projected on a screen and lighted up in all their details by the aid of the electric light. The most interesting scene of all, however, was that in the great hall of the library (illustrated on page 2332), where, on its numerous shelves and tables, were exhibited thousands of scientific, artistic, and industrial curiosities that served to excite the interest of the guests in the highest degree. Here were statues, statuettes, antique vases, and artistic objects in crystals; further on, physical apparatus embodying the latest discoveries, machines of the most novel kinds all in motion, and improved processes in the arts of engraving, metallurgy, etc. It is estimated that fully five thousand persons took part in this brilliant entertainment.

The Association, before its adjournment on the 29th of August, met again in the Sorbonne and elected M. Krantz as its presiding officer for the Congress of 1880, and designated Reims as the place for the reunion of that year.

THE FAÇADE OF THE SWISS SECTION.

THE façade which stands at the entrance of the Swiss Section in the Paris Exhibition is both ornamental and characteristic. Its style and architecture correspond to the most expensively finished chalets of Berne. In the middle of the central balustrade is placed an automatic clock as a symbol of the most flourishing industry of Switzerland. It is adorned with figures from the various cantons of the republic. At the highest point on the front is seen the national legend of the Swiss Republican Union—"All for one and one for all."

BAVILLE'S TOOL-HOLDERS.

DURING the past few years the practice has largely extended of employing in lathes, slotting machines, etc., tools formed of comparatively small pieces of steel held in special tool-holders in place of the ordinary tools, forged from steel bars of various dimensions. Among the varieties of tool-holders which have been introduced for carrying out this system are those of M. Baville, whose ingenious tool-holders have been very extensively adopted on the Continent, while more recently their manufacture has been taken up in this country by Messrs. Greenwood & Batley, of Leeds, who show specimens at the Paris Exhibition. We give engravings of a number of these tool-holders on next page, our illustrations and particulars being reproduced from *Armengaud's Publication Industrielle*. It will be seen, from the description hereafter given, that the details of this system of tool-holders have been exceedingly well worked out.

Tool-holder for Lathe.—The first example illustrated of M. Baville's system of tool-holders is that shown in Figs. 1 to 4, as adapted for lathe tools. This tool—shown in longitudinal section, Fig. 1; in horizontal section, Fig. 2; in front elevation, Fig. 3; and in vertical section, Fig. 4 (on lines 1-2)—consists of two main parts, A and B, fitted together and fastened by screws, *a*, so as to present a cylindrical head, in the interior of which is placed the movable nut-shaped piece, C, which holds the cutter, D; this "nut," fitted exactly to the receptacle formed to hold it, in the interior of the parts A and B, is of a spherical shape in the middle, with a conical part above and below, terminating in a cylindrical tenon forming two pivots, on which it can make a rotary movement of half a circle. The circumference of this sphere is cut with a thread, *c*, gearing into a worm, *b*, the journals of which are made square at the ends to receive a handle, *d*, by the aid of which it can be turned. In order to hold the tool firmly, this nut, C, is pierced by a slightly angular opening (shown in Fig. 4) corresponding to the section, D, of the cutter, which fits in very accurately, leaving room however for the insertion of the wedge-shaped piece, *e*, which is screwed down tightly by the screw, E.

This short description will give some idea of the valuable service a tool can offer which, like this, can act at will perpendicularly or parallel to the axis of the lathe, or in any of the intermediate oblique positions; further, by means of its simple form and mobility, it can be employed in working on certain interiors, ordinarily requiring a tool forged to a special shape.

The cutting tool being placed in the tool-holder, and fixed in the best position to suit the work, it is indispensable that it should be absolutely fixed in that position; a brake is therefore applied to the axis of the worm, *b*, in such a manner as to insure the rigidity of the nut, C, in any desired position; this brake consists of a wedge, *f*, acted upon by means of the screw, G, so as to press it, by the interposition of the plate, *g* (Fig. 1.), on the two half journals, *h*, embracing the axis of the screw half its circumference. Only part of the means employed for fixing these two parts together is indicated by the screw, *a*, which holds together the two jaws, A and B, joined very accurately one upon the other, one of which contains two tenons which go into the grooves, *i*, made in the other, and which are shown in Figs. 1 and 3. This screw alone would not suffice, so in addition to this the two parts of the head of the tool-holder are fixed together above and below the nut, by means of two rings, *j*, fitted in like hoops. It will be evident that everything possible has been done to insure the solidity and good working of this tool-holder.

Simple Tool-holder for Planing Machine.—In this tool-holder (see Figs. 5 to 8) the same general features in principle are observable as in the preceding one, but it has in addition a small special mechanism so arranged as to permit of the tool being slightly inclined on the return stroke, in order to prevent it from becoming blunt by rubbing on the work in going backward previous to commencing a new cut. Of course it is well known that the majority of planing machines are so constructed as to do this, but in those machines the whole tool-box has to be inclined, whereas in this case it is only the cutter which needs moving, and being very light the cutting edge does not get blunted by the friction so soon as in the machines now in use, there being less weight of tool-box on the edge of the tool.

This new tool-holder is shown in vertical section, Fig. 5

and in front elevation, Fig. 6. Fig. 7 is a sectional plan on line 3 and 4, and Fig. 8 a back view of the tool-box to receive the tool. It is composed of a vertical piece, A, terminating in a cylindrical part in which the head, C, is adjustable; this, as in the preceding case, can rotate by the action of the worm, *b*, and is widened out to receive the tool-box, B, in which the tool, D, is held by the screw, E. It will be noticed that the tool-box, B, does not fit close into the space left to hold it in the head, C; this permits a slight oscillating movement of the steel pin, *a*, fitted half into each of the two pieces (see Fig. 8).

When cutting, the tool-box, B, occupies the position shown in Fig. 5, and takes its bearings on the head at the angular parts, b^1, shown in Fig. 8, so as to maintain the rigidity of the cutter by its adjustment. In the movement in the contrary direction, the simple contact of the cutter on the piece under operation is sufficient to make the tool-box, B, rotating on the pin, *a*, reverse itself and give the necessary inclination; and further to provide against the tool-box, B, being shaken in its various motions, the two springs bring it back constantly to the proper working position. The upper part of the head, C, is toothed to gear into the worm, *b*, by means of which it can rotate in its own bearings and give the desired position to the cutter; it terminates with a screwed end on which the tightening nut, F, is fitted so as to hold it firmly in the tool-holder. The worm is also provided with a brake composed of the screw, G, and wedge, *f*, which act on the journals, *b*, clasping the screw spindle. The different parts just described are covered by a plate, H, Fig. 5, screwed on the tool-holder, and which is supposed to be lifted off in Fig. 6.

Double Tool-holder for Planing Machine.—This tool-holder, shown by Figs. 9 to 12, is arranged so as to hold two cutters working in a parallel and alternative manner, that is to say, without any time being lost in the return motion; each of these cutters is provided with the necessary receding motion; but as the double tool is usually employed only in planing great surfaces, the tool-holder is not arranged for working at different oblique angles. This tool-holder is shown in longitudinal section on the line 5 and 6 in Fig. 9, in transverse section on lines 7 and 8 in Fig. 10, in sectional plan on line 9, 10 and 11, Fig. 11, and seen below in Fig. 12. In studying these figures it will be seen that the head of the tool holder, A, is hollowed out to form two cavities of trapezoidal shape, exactly alike, to receive the two boxes, B and B^1, in which the two cutters, D and D^1, are fitted; these are held by the set-screw, E, and each one of these boxes, as in those previously described, is capable of being oscillated on the pin, *a*, and brought back by the two springs, *i*, into their proper working positions.

Shaping Machine Head.—In this arrangement (see Figs. 13 to 16) most of the leading features already noticed in the two tool-holders previously described are also recognizable. Thus the head, that is to say, the movable part of the shaping machine, is provided with two tools, the one working in an inverse direction to the other, and subjected respectively to the inclination during the receding motion; but in this case the aim has been to make the distance between the two tools variable at will, that is to say, the one being fixed, the other can be placed nearer or further apart, as may be desired, hence the difference in the construction of this tool-holder and the one previously described. Fig. 13 shows the head of this tool-holder in longitudinal section on lines 12 and 13. Fig. 14 shows a similar section on lines 14 and 15 of the second tool; Fig. 15 is half front elevation and half section; Fig. 16 is sectional plan on lines 15 and 16, as seen from underneath. If Fig. 14 be examined, corresponding to the cut made by the fixed tool, it will be seen that this tool, D, is arranged precisely as the preceding one, that is to say, it is fitted in the interior with a tool-box, B, oscillating on the pin, *a*, as its axis during the receding motion, and the whole is lodged in a cavity reserved for it in the head, A, and is held by a screw, E, the small spiral springs, *i*, acting so as to allow for its inclination as in the preceding examples.

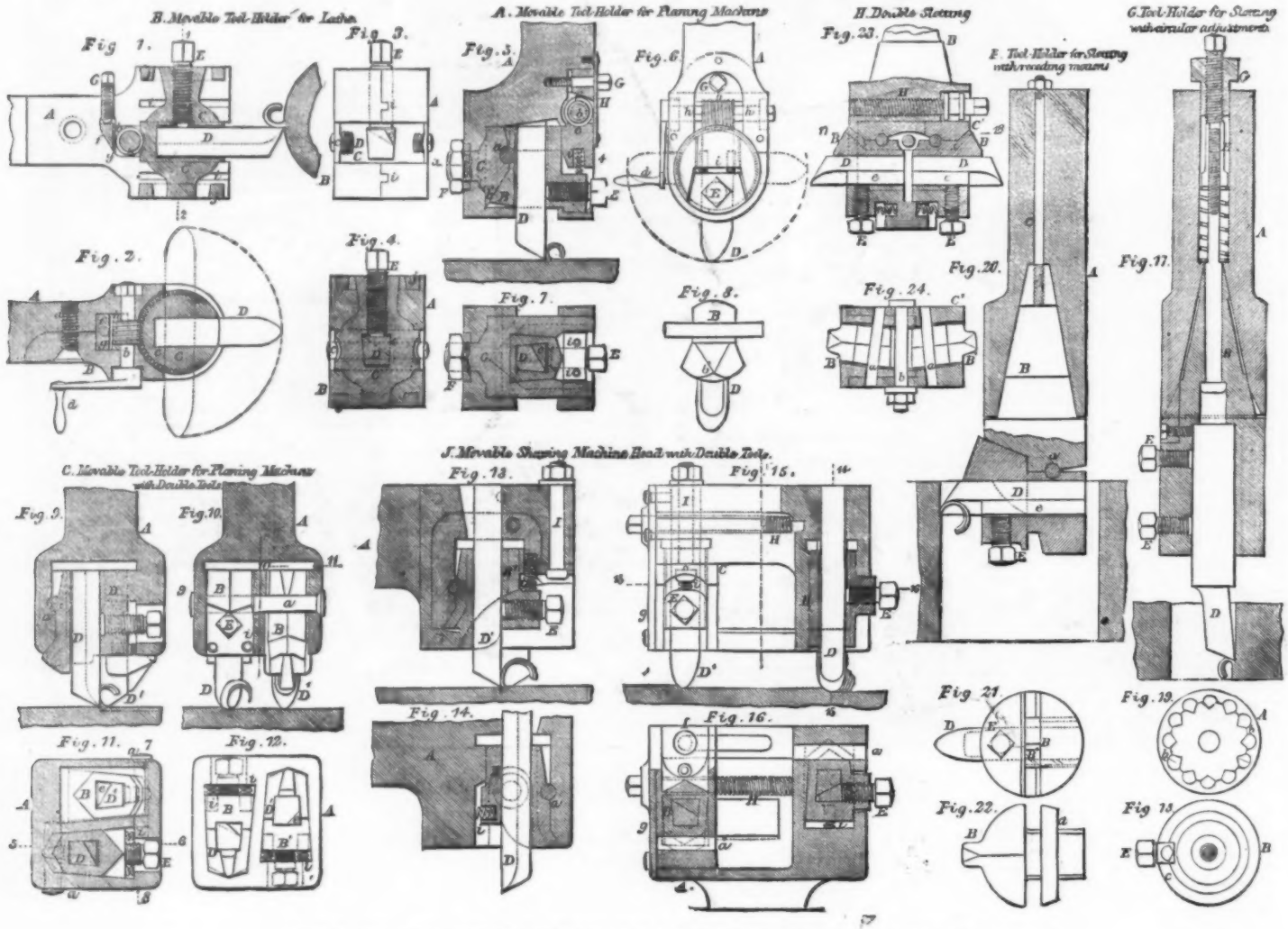
The second tool, D^1, is adjusted in an oscillating box, B^1, but this box, instead of being fitted directly on the head, A, plays in the interior of block, C, which is then fitted in the head in such a manner as to slide therein; in other words, so that it can be moved about according to the distance desired to be given between the two tool-holders, D and D^1. This shifting motion is effected by means of a handle working on the regulating screw, H, and when in the required position, the block is fixed in its place by means of the bolt, I; it will further be noticed that when the block is in its place at the exterior, the extremity of the head, A, is covered by a strong plate, *g*.

Simple Tool-holder with Vertical Cutter for Slotting Machine.—A cursory glance at Figs. 17 to 19 will show that in this case also Monsieur Baville has sought to reduce to a minimum the size of the cutter, to make the position of this tool variable at will, round its center of motion, and lastly to give it the faculty of receding during the return stroke, but the mechanism employed in this instance is of a very different nature to that previously described. Fig. 17 shows a vertical section of the tool holder, A, of a slotting machine having a vertical reciprocating motion. In this the base is hollowed out to a conical shape to receive the piece, B, of corresponding form, wherein the tool, D, is firmly fixed by two screws, E; this piece is seen in plan in Fig. 18. Fig. 19 is a view of the tool-holder, A; looking underneath, the lower orifice of the conical opening is shown fitted with a certain number of conical notches, *b*, into which a detent pin, *c*, of corresponding shape can engage, which is fixed by a screw, *d* (Fig. 17), in the box, B, of the tool, D. In this manner it is possible to change the position of the cutter with regard to the tool-holder as many times as there are notches, *b*, and in each one of these positions the rigidity of the tool is effected by the penetration of the detent pin in one or other of these notches. This gives the cutting tool the means of acting in all directions.

The tool-box of the tool-holder is held in a vertical position by a long bolt, C, the upper threaded extremity of which is fitted into a socket, F, which is also threaded on the exterior to receive the nut, G, ending in a cylindrical socket fitting accurately into the central hole of the head, A. Now if this nut came lower down, and closed tightly on the extremity of the head, A, the tool-box would be perfectly solid; but as it is, there is a certain amount of play between the nut, G, and the head, A, the use of which is as follows, viz.: Suppose for instance the tool-holder is moving downward; as soon as the cutter meets the article under operation, an intimate contact is established between the two conical parts, A and B, and the tool is firmly thrust in the direction of its work; on its return stroke, the tool-holder, A, rises first, and only lifts the tool-box at the moment when the top of the piece, A, meets the nut, G; thereupon, not only is there a disengagement of the conical parts, but sufficient play is left between them to permit the piece, B, to be thrown out of center, and so as to allow of the tool receding sufficiently to clear, in returning over the part just cut. Beneath the socket, F, there is a spiral spring, *i*, to give these pieces the solidity necessary for good work.

Tool-holder with Horizontal Cutter for Slotting Machine.—Fig. 20 shows a vertical section of the tool-holder for a slotting machine, in which the cutter is held horizontally; Fig. 21 is an inverted plan, and Fig. 22 is a view of the oscillating tool-box alone. In this arrangement, as in the preceding one, the tool-holder, B, is a cone, fitted with the head, A, but in a perfectly rigid manner by means of the bolt, C. In this the cone, B, is arranged at its lower part to receive the oscillating box, B^1, in which the tool, D, is fixed, same as in the tool-holder of the planing machine, by means of the screw, E, pressing on the wedge, *e*. It has been already explained how this tool-box gives way on the receding motion, by oscillating on the pin, *a*; the only points to which attention need be drawn, as presenting any differences from those previously described, are the changes of form adopted, which are well shown in the accompanying illustrations, principally in Figs. 21 and 22, which show clearly the separate parts, and the means adopted for securing the contact by inclined planes, and thus insuring their perfect stability.

Double Tool-holder with Horizontal Cutters for Slotting Machine.—This latter tool-holder (see Figs. 23 and 24), which by its conical piece, B, may be substituted entirely for the preceding, on the head of any kind of slotting machine, is specially arranged for slotting axle boxes. For this purpose it is made double, that is to say, provided with two cutters, D and D^1, placed horizontally, and in such a manner as to work simultaneously; each one is fixed in an oscillating box, one of the boxes being fixed in the slide rest, C^1, moved by

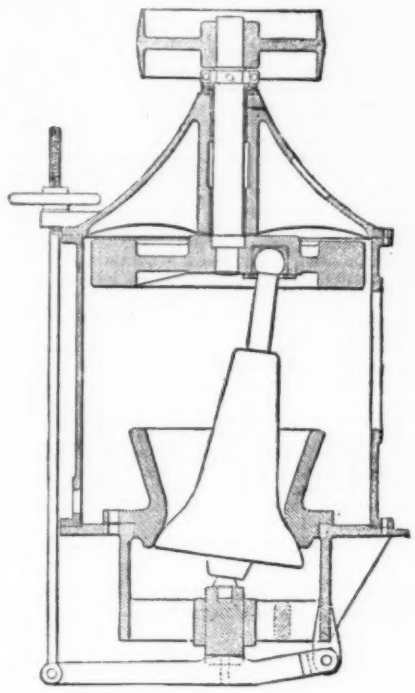


THE PARIS EXHIBITION.—BAVILLE'S TOOL HOLDERS.

OSCILLATING STONE CRUSHER.

In the accompanying engraving we illustrate a crushing mill which has proved very efficient in practice for reducing stone and other hard substances to various degrees of fineness. It was invented by M. Motte, of Belgium. It is known on the Continent as the pestle and mortar mill, owing to the configuration of the main working parts. The receiver or mortar is firmly attached to a foundation plate, the whole being secured by holding-down bolts. The mortar has no bottom, but the lower portion is widened out to a bell-mouth, in which the pestle works. This latter detail has a revolving and grinding motion imparted to it, being attached at its upper end by a ball and socket joint to a horizontal flywheel. The pivot of the pestle rests on a lever which may be lowered or raised by means of the screw and handwheel seen on the left of the mill. The pestle itself slides upon the shaft by which it is connected with the ball and socket joint. By this means the spherical opening between the mortar and the pestle may be regulated so as to give the reduced products the necessary degree of fineness, and until they have reached the proper size they cannot pass out of the mill, so that the necessity for re-working portions of the crushed material

cannot arise. The flywheel and its shaft receive motion through the horizontal pulley at the top of the shaft, over which is passed a band from the engine. The whole of the main working parts are inclosed within a cast iron casing having an opening through which the material to be pulverized is fed into the mortar. The chief working parts are made of crucible steel, and the shape of the pestle and mortar is such as to insure a minimum amount of wear in working. This wear takes place very gradually and uniformly, and is

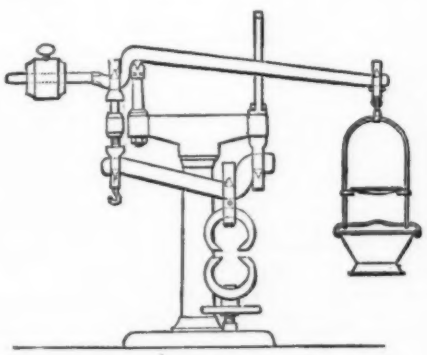


PESTLE AND MORTAR STONE CRUSHER.

easily followed up by the adjusting arrangement, so that the efficiency of the mill remains unimpaired. The mill is useful for many purposes, as in road making, mining, and various manufactures. Upon a recent occasion we inspected the working of one of these mills at the works of the manufacturers at Dartford. A quantity of cement clinker was put through the machine, and its reduction was very satisfactorily effected. The machine is very compact, and is small in proportion to the work it performs.

CEMENT TESTING MACHINE.

WE also annex an illustration of a cement testing apparatus on the double-lever principle, designed by Dr. William Michaelis, of Berlin, which is largely in use in Germany. It consists of a main standard about 15 inches high, to which are attached two levers, the leverage of the upper one being 10 to 1, while that of the lower one is 5 to 1. The lower lever carries one of the jaws for holding the briquette, while the other jaw is attached to the base plate of the machine, and is vertically adjustable by means of a hand wheel and screw. From the end of the long limb of the upper lever is suspended a weight pan, with hooks at the lower end of its framing for carrying a receiver for holding shot. When at rest the knife edges of the levers should be on a level, their adjustment being effected by means of the counterweight on the short limb of the upper lever. In operating with this



TESTING MACHINE FOR CEMENT.

apparatus the briquette is placed in the holding jaws, which are then adjusted by means of the hand wheel and screw. Fine shot is then poured into the suspended receiver until the fracture of the briquette takes place. The receiver with the shot is then weighed by an ordinary pair of scales, or it may be weighed on the apparatus itself by hanging it on the hook of the connecting link between the two levers, the weights being placed in the weight pan. Weighing by independent scales, however, is more expeditious. The weight of the receiver and shot multiplied by 50 represents the tensile strength of the briquette per square inch of sectional area. The apparatus is portable and does not require to be fastened down for use. It is about 23 inches high and 25 inches long, and only weighs a little over 50 pounds.—*Engineering.*

THE CARBONIZATION OF WOOL AND WOOLEN CLOTH.

IN our issue for June we drew attention in a short article to the carbonization of wool, expressing the belief that this process, though now much resorted to on the Continent, seemed to be unknown to many manufacturers in Great Britain. Numerous inquiries on this subject which we have since received have confirmed this belief, and have induced us to take considerable pains in order to ascertain more completely the details of this proceeding as carried out on the Continent; our limited space, however, does not allow us to enter into all the minutiæ, which those who wish to profit by it will by experience soon discover for themselves.

The expression "carbonization of wool," though general on the Continent, is not, strictly speaking, correct, for it is only the carbonization of the vegetable substances contained in the wool, not of the wool itself. Every woolen spinner knows to what extent the wool coming to us from Australia and South America is mixed with all kinds of vegetable substances, such as food, dried leaves, and, above all, thistles. The retention of these is greatly aided by the formation of the hair itself, which is not smooth on the surface, but consists of a series of scales overlapping and lying in one direction. To test this it is only necessary to draw a human hair between two fingers; if drawn in one direction it will be smooth, but if drawn in the opposite direction will be distinctly rough. From this it will be evident that if the hair of a sheep's coat comes in contact with any substance having fine edges it has a tendency to seize it, and as there are many hooks, so to speak, on each single hair, it follows that it is easy for a bunch of wool to take up and retain bodies of considerable bulk. Among the substances thus held none cling more firmly than seed pods of thistles, always numerous when the vegetation is luxurious, for these have themselves small serrations facilitating the embraces of the wool.

The removal of dung and other soft impurities is not so difficult, as they yield readily to a vigorous washing, but the seeds of thistles or the prickly leaves of many plants are more difficult to get rid of, especially when these seed pods, or, as they are called, burrs, are crushed and broken, for then the smaller parts are most difficult to seize. In minor establishments the wool is often picked by hand to free it from these burrs, but in larger mills the work can only be done by machinery, and then may be divided in two sections, viz., that done by mechanical means, and that accomplished by the newer chemical processes of carbonization. The advantage of the latter consists in the destruction of the vegetable substances without injury to the wool, which cannot be avoided where the objects have to be forcibly torn from the wool by willies, teasers, and burring machines.

The process in question consists in the reduction of the vegetable matters to an easily removable cinder or charcoal dust, and is thus in reality almost identical with the manufacture of shoddy from rags containing wool and cotton. This, like many chemical manipulations, is partly the product of foreign intellect, the merit of its first application being divided between the German Kober, the Englishmen Fenton and Crone, and a Frenchman, Isard, who patented his process in England in 1854. The process consists in the application of diluted sulphuric acid of 4 to 5 degrees B., and exposing the cloth to a temperature of from 250 to 300 degrees Fahrenheit. A later patent taken out by Joly consists in the use of hydrated chloride of alumina produced from pure clay, but this necessitated a higher temperature. In all there are from thirty to forty different applications of the same idea, some using muriatic acid, some adding alum, borax, etc.

The object of all these ingredients is to deprive the vegetable substances of a part of their hydrogen, without which they are almost entirely only carbon or charcoal. All the processes may be classed in two categories, viz.:

(1) Carbonization with liquid acids, salts, etc.
(2) Carbonization by the application of gases.

The former may be divided into three operations.

(*a*) Immersion of the wool or cloth into the liquid acid, showing 3 to 4 degrees B.
(*b*) Partial drying in a centrifugal machine.
(*c*) Exposure to a temperature of 212 degrees.
(*d*) Removal of the acid for the application of dyes.

As an illustration we will explain three different proceedings, premising, however, that sometimes it is more convenient to carbonize the cloth than the wool:

Frezon's process is specially suitable for cloth, but possesses the disadvantage that it can only be applied to white or indigo-dyed cloth, and has, moreover, the drawback that small quantities of acid are apt to remain notwithstanding all care in washing. It is evident that most colors must suffer when treated with sulphuric or other acid, and the cloth, and with it the dye, being dried at a temperature of from 210 degrees to 230 degrees, it follows that alkaline baths to which it may be subjected afterward cannot fully restore the color thus injured.

Experiments demonstrate that wool treated with acids always suffers more or less. When the idea of carbonization was first tried it was found that the cloth made from it did not mill well, and the more so the more grease had been left in it; not only was the milling defective, but the washing was difficult; there was more waste, and it was plain that the wool was not in as good a condition as when untouched with acid. This, however, was no reason why the idea was to be condemned; it was only necessary to alter the time of its application, and by introducing it after the milling to the cloth these inconveniences were almost totally removed.

Lix's method is similar to the foregoing; by it the vegetable substances are likewise treated with acid and subjected to the action of heat, by which they get so charred that in the subsequent treatment of the wool they drop out of it in a powdered state. This treatment requires, however, care, so that the wool is not injured. In order to protect the woolen goods from the action of the acids it was proposed to mordant them previously in a solution of salts, such as alum, salts of tin, or others, but experiments made by Dueux, Lechartier, and Raulin have proved that such saturations do not protect the wool, while the wool so treated did not take the dye so well as that not so prepared. Lix proceeds as follows:

The wool or cloth to be carbonized is passed through a bath of sulphuric acid of 3 degrees to 6 degrees B., to which is added, according to the quality of the cloth, a certain quantity of alum, salt, and borax.

As a usual mixture is recommended: 17 gallons of water acidified as above, 1 lb. alum, ½ lb. salt, and 1½ oz. borax; the wool or cloth is stirred or turned for about one to two hours, then desiccated in a hydro-extractor, and dried at a temperature of 210 degrees to 230 degrees. To prevent injuring the wool it is of the highest importance that every trace of the acid be removed, an operation which requires the utmost care. For this purpose the cloth (or wool) is washed in a good washing machine for an hour in pure soft water, then with fuller's earth, and afterward with soda, and finally again with water.

As with the previous process, so is this one only suitable for undyed or indigo wool and cloth, but in order to be able to apply it also to dyed goods, the inventor uses chloride of zinc and chloride of manganese diluted to six degrees, and proceeds with this as above indicated for a bath of sulphuric acid, alum, salt, and borax.

As in many piece goods the ends and the number of the piece are woven or stitched with cotton, and this must not be destroyed, it is necessary to cover these when coming from the hydro-extractor with a paste made of fuller's earth and equal parts of soda and sal ammoniac, which will protect them against the action of the acid.

Joly's process, which is the third we will explain, has many advantages over the preceding ones, which latter were so far open to improvement as it was always risky to operate with a material which may cause harm through carelessness of the workpeople; these men were, moreover, exposed to a great deal of inconvenience by the rising vapors from the acids, and could not work in anything but pure woolen clothing. The task set to inventors was thus to find a substance which should not have these disadvantages, and at the same time possess such an affinity for the matter, or for the hydrogen contained in vegetable substances, as by contact to deprive them of it.

After many researches M. Joly found these qualities in hydrated chloride of aluminum, a substance which, until then, was not of commercial importance, but which is now manufactured specially for carbonization purposes, and sold, we believe, at about fifteen shillings per cwt. We may mention in passing that, like many inventors, M. Joly never realized the benefits of his invention, for having to contest his patent with M. Frezon, the trial was decided in his favor the day following his death.

According to Joly's patent, a solution of chloride of aluminum of the strength of 6 to 7 degrees B. is formed, in which the wool or cloth to be operated upon is put, and left until completely saturated, the proportion being about 8 lbs. to 10 lbs. chloride of aluminum to 16 lbs. of wool or cloth. The wool (or cloth) is then whizzed in a hydro-extractor, and well dried in a moderate temperature. The liquid running from the hydro-extractor must be collected, as it can be used again. Not until now does the dried wool pass into the carbonizing room, which is heated to 212 degrees. This chamber is, when a larger quantity of cloth is to be treated regularly, constructed similar to a cloth-tentering machine. After an exposure of about three quarters of an hour it only requires a simple washing with water, or, better, with water and fuller's earth, to remove all traces of the chloride. The great heat, to which objection has been raised, is no detriment to the wool itself, and Joly's process has the advantage that the substance used may be freely handled, without inconvenience, by bare hands. Care must be taken that the cloth, when introduced into the stove, is perfectly dry, else the latter will have to perform a drying as well as a carbonizing operation.

The latest improvement in the carbonizing chamber consists in the introduction of a machine having three or more tin cylinders heated with steam at a pressure of 60 to 70 lbs. per square inch; the cloth comes thus on both sides in close contact with the hot metal, which has the same effect as exposure in the stove. Carbonization by means of chloride of aluminum seems now to meet with most general adoption, especially as it can be applied without risk to all colors.

Another method, recently described in detail by Mr. Victor Joclet, is—

Carbonization by Means of Gas.—The main feature in this is the introduction of the fumes of muriatic acid among the wool. The apparatus employed is an air-tight chamber in which the wool is loosely placed upon hurdles; the muriatic acid gas is then introduced, and the wool exposed to its action from three to four hours, when the flow of the gas is stopped, and, by means of steam pipes, the temperature raised to 212 degrees or higher. After a short time all apertures are opened, atmospheric air introduced to remove the fumes of gas, and the wool then washed as before indicated. It is important that with this treatment the wool be uniformly dry, but not too dry; a trifling presence of moisture assists the action of the gas, while larger volumes of water would produce liquid muriatic acid, and thus injure the wool. The fumes of muriatic acid may be produced by the evaporation of the liquid acid, but it is better to produce the gas direct from ordinary salt and sulphuric acid of 66 degrees B., mixed carefully in an earthen vessel, and conducted by leaden pipes.

A modification of this method is the evaporation in the chamber of ammonia, placed on the floor in glass vessels. When the introduction of muriatic acid has ceased, and the temperature has been raised by the action of the ascending gaseous ammonia, the superfluous hydrochlorine acid is neutralized.

From the foregoing it will be seen that the process of carbonization consists in the destruction of all vegetable substances by the action of acids, either in a liquid or gaseous condition, or of chloride of aluminum, and that the latter is evidently the substance which offers the greatest advantages. We would, however, ask whether any of the processes described here are not more or less out of place in a spinning or weaving mill, and should not rather form an occupation by themselves? In this way the idea is carried out in several places on the Continent, in the same way as we have repeatedly pointed in the washing of wool, for which several large establishments are in existence. We know spinners have an aversion to parting with their raw material, but believe there is a great deal of prejudice in this. Do manufacturers not send their yarn to be bleached, dyed, and sized, and the cloth to be finished? We should think a carbonizing establishment would succeed if properly carried out.—*Textile Manufacturer.*

BEER.

THE *Chemiker Zeitung* presents its readers with the following receipt for making beer, which is now being sold by a Vienna laboratory for a fee of 15 florins, and which bears the signature of Dr. Max Raufer:

To the cold decoction of 70 grammes hops in 2 liters of water add 2½ liters of spirit, free from fusel, and train into a cask containing 25 liters water, ½ kilo of glycerine, of 30° specific gravity, and 20 grammes burnt sugar. To give it a "head" there are further added 200 grammes tartaric acid and 220 grammes bicarbonate of soda. In twelve hours the mixture is ready for use.

WASTE WATERS FROM WOOL SCOURING, FULLING, ETC.

By Ed. Neumann.

Two methods have hitherto been in use for treating the waste waters from washing wool, fulling cloth, etc. In the so-called lime process, the waters are accumulated in large tanks of masonry and mixed with milk of lime. A calcareous soap is produced, which, after the lapse of several days, separates as a muddy precipitate; the clear supernatant water is decanted or filtered through the hollow bottom of the tank, while the sediment is dried, and afterward treated for the extraction of the grease.

The advantage of this method is that all the waters may be utilized, even those containing but little fatty matter. Nevertheless it presents such inconveniences that it is not in very general use. A considerable space is necessary for the construction of the tanks, of which there must be at least two in number, to admit of continuous working, and which ought to contain 80,000 to 100,000 gallons. This necessitates consequently a large original outlay. The drying process and the removal of the residue require much labor, which considerably enhances the cost price of the matter obtained. Hence small establishments and those with whom space is an object cannot employ the lime process.

In the second process, which has been hitherto most employed, the fatty matters are separated by means of sulphuric acid; after settling for a certain time, the layer of impure fat, mixed with mud and hairs of wool, which floats upon the water, is removed with skimmers. The water mechanically mingled is pressed out in the cold; further pressure is then applied with the aid of heat in order to extract the grease.

This method also presents many inconveniences. It likewise involves a very considerable initial outlay on account of the quantity of plant which it requires, and although these inconveniences are not as serious as in the lime process, this system is remunerative only in large establishments.

The waste waters are conducted into large casks fitted with cocks, and mixed with sulphuric acid until they give a slightly acid reaction, then heated with steam to a boil. After boiling for four to six hours it is let settle for some time, until the grease is entirely separated and floats on the surface. It is then skimmed off, and the water is run off at the cocks. When a large quantity of impure grease has been collected in this manner it is boiled once more and pressed.

It is easy to understand that these operations are costly, and that only the richest waste waters can be utilized. Furthermore, this method is productive only when the wool or the cloth has been scoured with urine. It is not economical when alkaline lyes have been made use of, which is often the case. A further very serious inconvenience of the acid method is the offensive odor evolved, which renders it necessary to carry it on in retired places.

M. Neumann's method is available in all cases, whether urine or soda-ash, etc., has been used; it renders the treatment of the poorest waters practicable, and it is applicable even in the smallest establishments.

He dissolves in an equal weight of water crude chloride of calcium, or any other salt which forms with fatty matters a soap insoluble in water. Of this solution from 1 to 2 per cent. is added to the waste waters, which must have been collected in a suitable tank. A calcareous soap is immediately formed, and separates in the shape of fine flocks, which remain in suspension in the liquid. When the reservoir is full its contents are pumped into a filter press, and in the meantime the next quantity of waste waters is run into another reservoir into which the needful quantity of chloride of calcium solution has been placed.

The calcareous soap, the dust, hairs, and other impurities remain in the filter press, and the water containing in solution potash, soda, and any excess of chloride of calcium runs away perfectly clarified. After the first reservoir has been pumped dry the second is emptied and the first filled again, thus working the two alternately till the press is full, and its cocks only dribble slightly. The press is then opened, and the cakes are removed by means of a wooden shovel. The press is then closed up again, the pump set in action, and the work recommences. The only operations which require the intervention of a workman are putting the chloride of calcium into the tanks, opening and closing the cocks, taking out the cakes from the press, and setting the pump in action. These various operations are done in a few minutes, and do not require a special workman.

The cakes taken from the press are dried in the air, and used for the manufacture of gas, or else they serve for the extraction of grease. The extraction of grease constitutes a distinct part of the treatment of the waste waters, and in large establishments may be undertaken on the premises, but in small woolen mills it is better to sell the cakes to oil and grease refiners, etc. If in place of chloride of calcium products of small value (for instance?) are used, which do not need to be recovered, the extraction of fatty matters is still more simple and less costly.

This method presents these advantages:

It requires only a small outlay and little room, because the extraction of the soap is effected continuously as the waters flow away. The channels, pipes, etc., are always perfectly clean (?). The treatment of the poorest waters is remunerative, and almost all the oil and soap employed are recovered. The value of the cakes obtained allows of their being sent to a distance.—*Deutsche Wollengewerbe.*

ECONOMICAL EVAPORATION.

Among the many curious and interesting machines exhibited at the Paris Exhibition of 1878, one for the cheap evaporation of salt solutions is well worthy of notice. It serves for the separation of salt from water in places where fuel is difficult to be obtained, and, better still, where there is a waterfall.

It is well known that to raise the temperature of water from 0° to 100° C. it is necessary to use up 100 calorific units for each liter, and further, to transform this water at 100° into steam at 100°, 530 more units have to be expended, so that altogether 630 units will have been used. The first 100 units give specific heat to the water, the other 530 give latent heat to the steam. Now nearly all this heat, which is produced by a large consumption of fuel, escapes in the steam, but if by some contrivance the ultimate result came out as cold water which had left its heat in the apparatus, there would be no further need of a fire to carry on the evaporation, and thus a great item of expense, viz., of fuel, would be saved.

Now an apparatus to do this work must be hermetically closed so that no air can get mixed with the steam inside, and also, although closed, it must be so constructed that the precipitated salt can be withdrawn regularly. Admitting that these conditions could be fulfilled, let us see how the heat of the steam could be utilized.

If the steam is taken by means of a pipe to the water which is to be evaporated, the steam will be condensed if the water is colder than the steam, and the latent heat of the steam, viz., 530 calorific units, will be transferred to the water. There are two ways in which this can be accomplished: First, when there is a hydraulic force at hand, the steam formed in the boiler is compressed by means of a pump. This raises its temperature. It then suffices to pass it back into the boiler in which it has been produced to condense it entirely; thus the latent heat absorbed by the steam in forming is made to pass back into the salt water. Secondly, when there is not a hydraulic force at hand, the temperature of the steam cannot be raised by compression, but it is made to pass into a second boiler a little colder than the first, where it is condensed; then the steam from the second is made to pass into a third, still colder, and so it is continued. This latter method has been employed for some time in distilleries and sugar factories, therefore it is needless to enlarge upon it here.

I now come to the description of the apparatus, a general view of which is here given. The salt water on arriving passes through a wooden tank, A, furnished with tubes inside; it then enters the principal boiler, B, where it is partly heated by the steam there; then it goes into a second boiler, C, where it is heated under pressure; from there it returns to B, where the pressure being taken off causes some of the water to turn into steam by means of the extra heat it gives out. From B the steam passes to the pump, where it is compressed; then back again to C, which is furnished with tubes inside like A; but in this instance the steam passes through the tubes, instead of, like the water, going through the tank itself. After having traversed all the tubes in C it is carried along back to A, where it passes through the tubes, and at last escapes from A in the state of cold water.

Let us now return to the principal boiler, B. It is a long cylinder, having several tubes connecting it with other parts of the apparatus. At one end it is joined to C by means of a small iron cylinder, which is fitted with valves worked so as to keep the water in C under slight pressure, and, therefore, a little lower than in B. At the opposite side of C there is another tube which conducts the water into B again, where, as before mentioned, it is turned into steam; thus there is a constant stream flowing between B and C. At the bottom of B there is a long curved tube, shaped something like the letter J, which is fitted with two valves, one above the other. When the salt is precipitated in B it is pushed over the edge of the tube by means of revolving arms inside. The upper valve being open, the salt falls on to the lower one; the upper one is then shut and the lower opened, and the salt falls into a bag placed to receive it. The valves are then put into their former positions for the next lot of salt. As the tube is a curved one, and the level of the water is kept higher than the lower valve, no air enters the boiler. It will thus be seen that salt water going in cold comes out as salt and cold water. But, as perhaps it may not be understood how this takes place, I will go over the whole operation, giving the different temperatures.

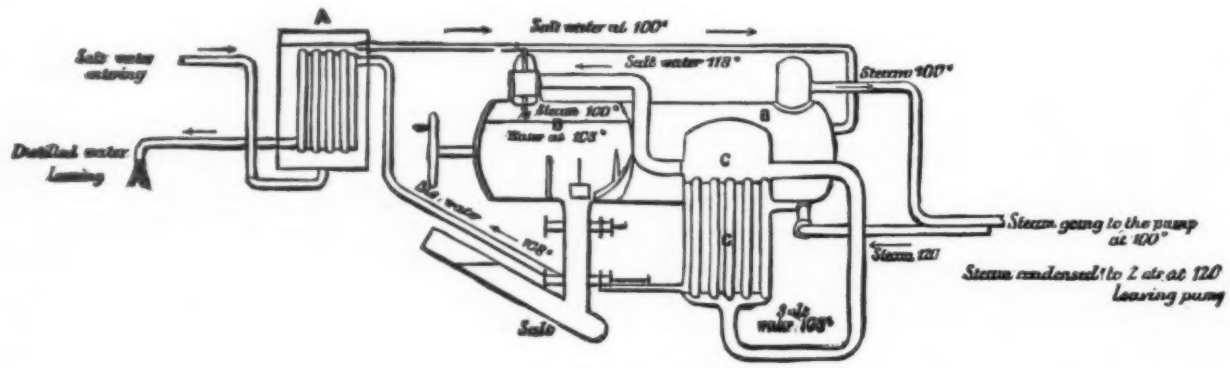
The salt water enters A cold, but as the effluent about to escape from the tubes in A is at 100°, it loses its heat and the water round the tubes acquires it. The water then heated to 100° enters the boiler, B; from thence it goes into C, where it is under slight pressure. The steam already in B is sucked out by the pump, and is forced into the tubes in C under the pressure of two atmospheres. This pressure raises its temperature to 120°, but as the water surrounding the tubes is colder, viz., 108°, the steam loses 12° of its heat, some of which passes into the water, which is raised to 118°. From C the water passes into B, where the water is at 108°, and, owing to the greater heat of the newly arriving water, a quantity of salt is precipitated, and is taken out as explained above. The steam which was in the tubes in C is condensed into water by losing some of its heat, and passing along a tube it enters the tubes of A at the temperature of 108°, and there transfers its heat to the cold water which is continually arriving, and, as before mentioned, the water leaves the tubes cold and free from salt.

From the facts here stated it can easily be understood that when the boiler is once heated there is no further need of a fire, as the heat is always kept inside. However, to prevent as much as possible any loss of heat from radiation, the whole apparatus is incased in sawdust, and, as a further precaution, the steam is put under a little more pressure than is necessary, and thus it is a little hotter than need be; but to prevent the heat gradually increasing, a small quantity of steam is allowed to escape occasionally, therefore the apparatus is kept as nearly as possible at an invariable heat.

M. Piccard, the inventor of this machine, has calculated that to produce 1,000 tons of salt in a year, counting 300 days, the condenser or large boiler, B, must have 40 square meters of surface, and the force of the machine should be equal to thirty horses. Even if a small engine was used to work the pump there would be a great saving of fuel; but if (as I mentioned at the commencement) the works are situated near a waterfall, there will be no need of one, as the pump can be worked by means of a turbine, and, therefore, the only need of a fire will be to heat up the boiler at the commencement of a new operation, or when the machine has to be stopped to be cleaned.—H. C., *in Chemical News.*

The most suitable time for felling timber, as regards its good qualities, is in midwinter and in midsummer.

Elevation and Part Section



ECONOMICAL APPARATUS FOR EVAPORATION.

A NEW DYE—ALIZARINE CARMINE.

The Austrian Alizarine Company (Przibram & Co.), of Vienna and Königsberg, near Eger, are now offering for sale a new dye named alizarine carmine, which promises to be of importance for woolen dyeing. It dyes upon wool, mordanted with tin crystals, an orange, and if prepared with alum, a red. With salts of tin it yields an orange, and with alumina, a red lake.

This coloring matter is a substitute for madder in all its applications in woolen dyeing, and exceeds it both in beauty and fastness.

The artificial coloring matters which have been hitherto sold as artificial alizarine, and which dye a yellowish red on cotton mordanted with alumina, give similar but less beautiful shades upon wool. That variety of artificial alizarine which dyes cotton a bluish red has not been hitherto applicable to wool. This can only be done by converting the coloring matter into a sulphacid, the salts of which are now introduced into the market as alizarine carmine. The alumina salt dyes unmordanted wool at once. It is, however, preferable to mordant the wool first, and to dye with the soda salt, with the addition of tartar.

Every mordant gives a different tone. In this manner a great variety of shades can be produced with this same color by the use of different mordants.

The scarlets, of course, can not compare with cochineal and eosine scarlets as regards brightness. Neither do they offer any advantage in price, notwithstanding the cheapness of artificial alizarine, but in their absolute fastness to light and air they surpass all others. Flannels dyed with alizarine carmine are improved in appearance every time they are washed, and are not saddened by the action of sweat. They can also, without injury, be exposed to full sunlight and every influence of the weather, an advantage not shared by the other coal-tar colors. It is, therefore, particularly recommended for carpets, uniforms, etc.

The following receipts may serve as a guide for its use:

Full Red.—The wool is prepared with 15 to 25 per cent. of alum and 5 to 6 of tartar, boiling for an hour, and then washed. Two per cent. of color are dissolved in boiling water, and mixed with 5 to 10 per cent. of tartar, which turns it yellow. Dye in this at a boil for one hour, and wash very well. Soak finally for an hour in a water at 144° Fahr. containing two per cent. of acetate of soda, or of curd soap.

A more scarlet shade is produced by adding to the alum bath one per cent. of tin crystals.

For a very dark purple, mordant with 10 per cent. copperas and 6 of tartar, proceeding otherwise as above.

For a light red, mordant with five per cent. tin crystals, and dye in a fresh bath with one per cent. of alizarine carmine.

For a reddish chocolate, mordant with two per cent. chromate of potash and four per cent. tartar, and dye in a fresh water with one per cent. of color.

It will be understood that the percentages are on the weight of the wool, woolen, or worsted yarn, etc., to be dyed.—*Reimann's Färber Zeitung*

BLEACHING OF TEXTILES.

By M. CLEMENT.

THE first operation in any bleaching process is to free the goods from the dressing which has been applied to them for the weaver's purposes; to this end the ordinary method of bleaching employs warm water and alkaline lyes. On the new system the operation is conducted in the cold, the cloth being steeped in water with the addition of yeast, and the sizes and dressings are got rid of without injury to the fiber.

After twelve hours this fermentation is at an end; the fabric is well rinsed, and passed into an oxidizing bath:

Water	10,000	parts.
New oxidizing salt	5	"

The proportions of this oxidizing bath cannot be given exactly, for it differs according to the degree of bleaching and the speed required.

After steeping for an hour it is strongly rinsed, and is then plunged into bath No. 2, composed of:

Water	100,000	parts.
Sulphite or hyposulphite of soda	150	"
Sulphuric acid	75	"
(Or muriatic acid	87½	")
Carbonate of soda or potash	25	"

After two hours' steeping the cloth is rinsed and placed in a bath of hypochlorite of soda, or of potash, having the following composition:

Water	100,000	parts.
Hypochlorite of soda	33	"
Carbonate of soda	250	"

After eight or ten hours cotton is completely decolorized, and requires merely to be rinsed, passed into bath No. 2 for an hour, rinsed again, and finished in the ordinary manner.

The bleaching of wools differs from that of vegetable textile fibers in the first preparation, which takes the place of the yeast. As an example is given the bleaching of raw wools. It is common to ungrease the wool either with the suint of an old bath or with stale urine (lant).

The new system differs by commencing with anointing the wool with oleic acid or with an emulsive oil. When this is done, after one or two hours of rest, or, better, more, the wool is washed in clean water, warm or cold, which is repeated until it runs away colorless.

The steeping in wool presents no inconvenience for the fiber; the wool being saturated with oil, can neither swell nor tear, and felting is rendered impossible.

All the earthy matter and other impurities which soil the wool are removed by this first washing; the wool is drained and washed again in a bath composed as follows:

Water (by measure)	1,000	parts.
Prepared liquid (do.)	15	"

The composition of this liquid is:

Liquid ammonia (by measure)	66	parts.
Petroleum ether (do.)	33	"

The mixture is well beaten up before pouring it into the beck.

It must be understood that any other essential oil or hydrocarbon will produce the same result. In this mixture the wool is thoroughly washed, and thus it is obtained white without losing in the least its softness.

If required, it may be further treated as cotton, omitting the hypochlorite baths.

Sponges are bleached by means of oxidizing baths and baths of hyposulphite, in preparing which oxalic acid is used instead of sulphuric.

By this system old flannels which have become yellow with wear may in a single operation be restored to the appearance of new material.

Sponges ought previously to be steeped in a solution of binoxalate of ammonia, fifteen or thirty grains to thirty-five ounces of water.

[We should think that the bisulphite of soda, or rather of magnesia, would be found preferable to the sulphite or hyposulphite of soda here directed.—ED. CHEMICAL REVIEW.]
—*Teinturier Pratique.*

COTTAGES.

"T. S." WRITES: *Accommodation and Arrangement.*—The size and number of rooms in a cottage should be in proportion to the number of its occupants, an ordinary cottage for a laborer having the following: Living room, entered from lobby, scullery, and three bedrooms, with pantry and other conveniences; living room with a superficial area of at least 150 feet, and 9 feet high; windows and doors arranged so as to leave one end with fireplace free, also as much of one side as possible, and, if cupboard, it should be placed on the opposite side of room to the fireplace; scullery with an area of about 70 feet superficial, with set pan, sink stone, water supply, and small fire grate, leaving room for washing or wringing machine; three bedrooms, varying from 80 superficial feet upward, 9 feet high, entered from landing, each with sufficient room for bed without interfering with half the door or window. The bedrooms should have wood floors, others stone or brick.

Points to be Guarded Against.—Building back-to-back cottages; staircase in center of cottage; sinks inside of a cupboard; waste pipes connected with drain at inside of house; cesspool under or close by a house; sleeping or living rooms below ground level, without open area in front and the whole length and depth of walls.

Foundations.—Where soil is naturally wet, a damp course of slate, lead, or boiled pitch, tar, and sand laid on the walls below ground floor level, usually 6 inches above ground line, will prevent dampness in walls. Hollow external walls add greatly to the dryness of a building.

Drains ought never to enter a house, and where obliged to go under, great care should be taken in giving them a solid and firm foundation, and the sockets securely joined with Roman cement, all other joints with clay. Drains should be trapped near to every inlet. All waste pipes, etc., should be discharged in the open air over a grate or inlet to drain. Provision should be made for taking away surface water; also, it is sometimes found advisable to drain the soil where very wet.

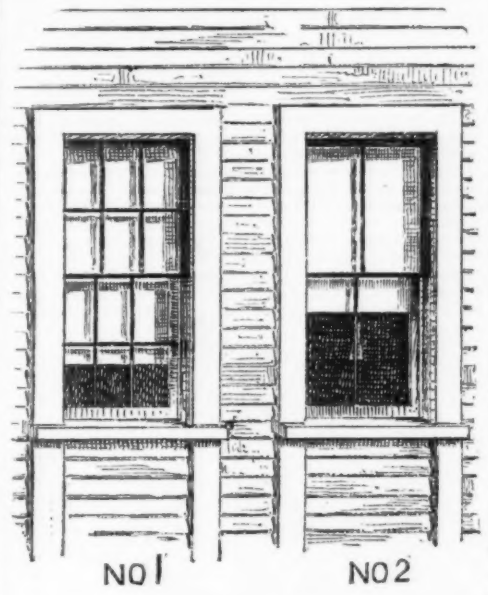
Light is very essential to make a cottage cheerful and healthy, and should be well diffused over all parts. Each room and staircase should have a window opening directly on the external air.

Ventilation.—The lobby, staircase, and landing ought to be ventilated by means of a direct communication with the external air on ground floor, and an escape for foul air through ceiling. Then each room near to ceiling should have a horizontal communication with the lobby stairs and landing, and at the opposite side of room an outlet at ceiling level. Bedrooms without fireplaces should be specially ventilated in this manner.—*Building News.*

WINDOW SASHES AND PANES.

THE arrangement of window sashes and the size and shape of panes of glass were regulated until recently by the limitation of glass manufacture.

The type of architecture had little to do with anything but the main contour of the opening; the filling in of transparent material being such as the market of the time or the means of the owner permitted. An exception might be made of the Gothic style, especially in ecclesiastical buildings, where stone tracery filled in with stained glass was considered essential to completeness of effect.



To-day the conditions are entirely changed, and one can live in a glass house without extravagance, or have, for a moderate outlay, large windows with but two lights. Plate glass can be obtained of almost any required size. Cathedral, stained, ribbed, hammered, ground and cut, painted and enameled glass may be had in infinite variety of styles and prices. There is practically no limitation, but length of purse, between the "old bottle bottoms," so called, in use in some of the modern English work and the immense and costly plates of a Broadway shop front.

The small number of windows noticeable in English dwellings is owing partly to the fact that our transatlantic cousins live much out of doors, using houses chiefly to sleep and eat in, and partly to the window tax, which, though now abolished, was long a heavy burden on this luxury. Instances were common in old buildings of windows being walled up in order to avoid this tax.

In America we have no practical restriction on the size or style of our wall openings. We may have many or few, large or small, with sashes to swing on hinges or slide vertically or horizontally, and we may glaze them with single lights of French plate or three-inch green "bull's eyes" at pleasure. Only one consideration should control us, and that is the common sense of design and construction, in short the fitness to use.

It is well known among inventors that a fortune awaits the man who shall contrive an acceptable substitute for the present box frame with its complicated, inconvenient and destructible machinery of pulleys, cords and weights. But it is likely that for some time to come we may have to endure this imperfect system and its attendant nuisances. The casement, or hinged window, is not suited to our climate, being very difficult to make weather-tight in winter, and seriously intervening in summer with those necessary protections, mosquito bars and Italian awnings.

To treat of the most common and practical phase of the subject let us confine our consideration at present to the double hung sashes as used in ordinary dwellings of moderate cost. In order to determine just how these should be arranged, divided and glazed we have first to note the purposes for which windows are intended. Their first and most important service is to admit the direct rays of the sun in order to promote the health of such human beings as are obliged by circumstances to remain indoors. Secondly, to enable the inmates to enjoy some part of the outer view when prevented by inclemency of the weather or other reasons from going out; and thirdly, to furnish direct free air ventilation both in summer and winter. The latter could be had if all openings were closed by shutters simply, as they were before the introduction of glass; but to gain the others glazing of some sort becomes a necessity. In order to fulfill their purpose fully the sashes of a window should be so arranged that they may be easily raised and lowered, and when closed be reasonably tight against the weather, and the glass should be easy to clean. In addition to this they should furnish, as far as consistent with their other uses, some protection against intrusion from without, and be safe in use to the occupants of the dwelling. Of course a reasonably large sash bar is more of an obstruction against intrusion than any ordinary glass. A large pane of the latter can be removed by a burglar from without noiselessly and without interference with a burglar alarm.

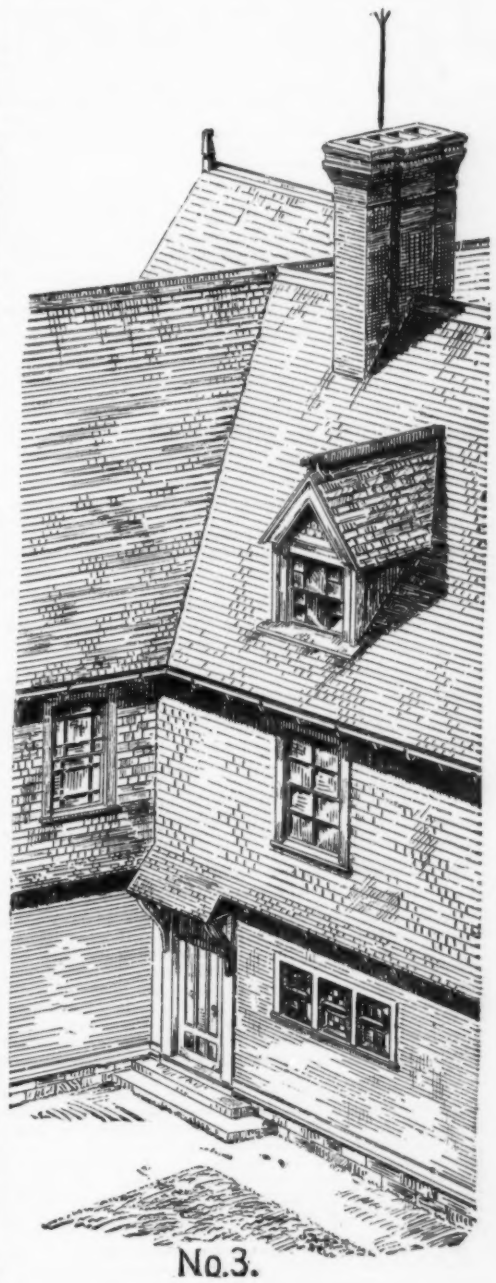
While it is desirable to admit sun and air freely to a house, it is impracticable, without the sacrifice of more important considerations, to make the confinement of a dwelling equal in extent of view and light to the outer world. Living indoors necessitates a certain amount of loss of freedom and health. The common uses of a house call for wall room for pictures, furniture, etc., and even the necessity for heating in winter restricts the area of window surface. So we see that there is a limit to the number and size of glazed windows, and this limit must be determined by a careful consideration of the circumstances of each individual case.

About twenty-five years ago there was practically but one idea concerning the division of sashes, and nearly all were made in twelve lights, as shown in sketch No. 1.

These were usually glazed with crown glass, which, from the nature of its manufacture, could not be had of large sizes, and plate was then very expensive. The sashes of this period were made very light, not more than 1½ inch thick, being stiffened by the frequent bars. A sash of this character was serviceable in most respects, but the bars interfered with any extended view, and the multiplication of corners rendered window washing difficult.

Not many years later the introduction of cylinder glass, which could be made cheaply of large sizes, led to the introduction of the style shown in sketch No. 2, of four lights to a window.

The size of the sash was somewhat increased, but not enough to compensate for the loss of strength by omission of the dividing bars and increased weight of glass. This novelty became popular chiefly because it was new, and not on account of a preponderance of good qualities. It had two advantages—the lights were easily cleaned, and the view, though awkwardly cut in two by the middle bar, was but



little obstructed. It had many faults. It was weak, the woodwork liable to spring and the glass become loose, and any breakage was more expensive to repair and left a bad opening to the weather until repaired. The removal of a single light gave room for a man to enter easily. The shape of the glass was awkward and badly proportioned. But the greatest inconvenience was in moving the sashes up or down. Supposing the window to be closed and to stick a little (as it must necessarily in warm damp weather in order to be reasonably tight in winter), and it were required to raise the lower sash. There was nothing to take hold of but the top rail, which is generally too high for a short person, especially for a woman, to exert any lifting force on. To obviate this difficulty the partial remedy of "lifting hooks" attached to the lower rail was adopted. Even with these it was impossible for any one to exert the force that he could on a horizontal bar properly located.

Two or three fingers of each hand were the most that could be brought to bear on them. But the difficulty with the lower sash was trivial compared to that with the upper. From the inside there was absolutely no way to lower it except by poking the lower rail down with the ends of the fingers, or grasping the upright middle bar and pulling by the friction of the hand. Of course neither way would prove effective if the sash stuck at all. Where mosquito

bars or screens were used in the common form the awkward expedient of raising the lower sash and grasping the lower rail of the upper outside with both hands was prevented by the upper rail of the mosquito bar, which usually came opposite the lower part of the upper sash.

Altogether the whole thing was clumsy and inconvenient in the extreme, and it is a wonder that it ever came into general use. It only adds another proof to show how unreasoning fashion is even when it concerns a matter of building, a department which least of all it should control.

Singularly enough what was adopted as a fashion is likely to be superseded by a better method, starting in a fashion also, but modified by judgment and experience into a system which will stand the test of reason.

The disciples of the "Queen Anne" revival, in architecture, disgusted with much of the inconvenient and unpractical modern Gothic work on the one hand, and the shams of speculative cheap building on the other, cast about for a style which should be picturesque and flexible and suited to everyday practical use. They hit upon one which it would be better to call "free Renaissance" than "Queen Anne," and with the simpler forms of which we are not altogether unfamiliar in our early colonial work. In these examples they found strong and solid window sashes with lights of various dimensions and shapes.

Some English and American architects, in adapting the style to ordinary modern wooden house construction, have rejected the very small panes, which are hard to clean, and whose numerous sash bars cut up the prospect into a checker board pattern, and have divided an ordinary window into eight good sized lights, making the sash two inches thick, and stiles, rails and bars of proportional width. The appearance of such windows (as in second story right hand of sketch No. 3) is entirely in keeping with all the features of modern domestic work, and any one who has had any practical exeprience would wonder that the former type was tolerated so long.

But this is only one of the many patterns which the new freedom in sash design is likely to bring into vogue. In left hand second story window of sketch No. 3 we have another arrangement for use where it may seem desirable to have one large light in the center of each sash. This light may be of thin plate, crystal sheet, or other clear glass, and the surrounding smaller ones of light colored glass if desired. Other patterns are shown in the attic "luthern" window and in the small first story ones, the latter adapted for stained glass.

Ready made window sashes are of course of the stereotyped and conventional forms, but a demand from the public for a proper variety will lead to a supply at reasonable rates.

The ordinary thick plate glass is almost perfect; the view through it being scarcely injured at all by the medium, but it is very heavy, and on that account becomes for ordinary houses at times dangerous, owing to the great weight of the sashes and necessary counter weights, and the liability to breakage of cords or glass. Considering the slight advantage of absolutely perfect transparency for common use, the very great excess of expense would seem to render the substitution of plate for good cylinder glass undesirable, except in large mansions or public buildings.

By making these and all other house building problems matters for serious and independent thought, we shall eventually be able to build with such regard to fitness that our simplest work will not be lacking in beauty.

J. A. F.

LIGHTHOUSE ILLUMINATION.

Mr. J. R. Wigham read a paper before the Mechanical Science Section of the British Association on "New Applications of Gas for Lighthouses. Illustrated by models, full-sized apparatus, etc.:

"1. The quadriform group-flashing light, as used at Galley Head Lighthouse.

"2. The combined gas and electric light for lighthouses.

"3. A mode of lighting sea beacons from a position on shore."

THE QUADRIFORM GROUP-FLASHING GAS LIGHT, AS USED AT GALLEY HEAD LIGHTHOUSE.

Galley Head, a promontory on the coast of Cork, about midway between Cape Clear and the Old Head of Kinsale, is a point in the neighborhood of which there have been several shipwrecks. The Commissioners of Irish Lights, therefore, determined to place there the most distinctive and powerful light which they could obtain. With this view, and acting upon the advice of Dr. Tyndall, their scientific adviser, they adopted the quadriform group-flashing gas light, Fig. 1, respecting which I now propose to say a few words.

It is perhaps known to some who are present that the Commissioners of Irish Lights were the first lighthouse authorities to make use of gas as an illuminant for important lighthouses. They have done me the honor of adopting the arrangements and burners for the consumption of gas which I have devised from time to time. My aim has been to combine the greatest possible intensity with the greatest possible volume in the gas flames which I employed.

Before showing you these flames, I may, perhaps, be permitted for a few minutes to explain some of the steps by which I was led to construct gas burners for lighthouses in the form in which they are now used.

Up to the time of my first experiments, only Argand burners had been used for the combustion of oil in first order lighthouses; but when it was attempted to construct Argand burners for gas, which should be of sufficient dimensions to give the same light as those used for oil, difficulties as to smoke and chimney-glasses interfered, and it became evident that some other method of burning gas must be sought for.

It occurred to me that if any plan could be devised by which the excess of carbon—the smoke—existing in rich gas-flames could be turned to account as a means of increasing their illuminating power, a valuable desideratum would be obtained. I accordingly made many experiments with that object, and came to the conclusion that I could find no better basis for my efforts to that end than the ordinary well-known fishtail jet. The fishtail jet, it is hardly necessary to say, is bored diagonally on opposite sides of a small internal cone. The streams of gas issuing from the orifices impinge against each other with considerable force, and the result is the thin sheet of flame with which we are so familiar. This flame, possessing a large surface, to which the oxygen of the air readily gains access, is in consequence rendered brilliant and comparatively smokeless. But on closely examining the flame of a fishtail burner, it will be seen that toward the top, where the force of the stream of gas is nearly expended, it is thicker, and inclined to be smoky. The larger the bore of the burner the thicker the stream of gas, and (its pressure and quality being good) the greater the amount of unconsumed carbon. When a number of fishtails are arranged so that the upper extremities of their flames touch each other, they run up, because of the absence of air between each jet, into smoky tails; but the light they give when thus united is increased, with hardly any increased consumption of gas, much beyond the mere multiple of their single flames, as may be seen in a moment by bringing two fishtails together. I made this peculiarity of the fishtail available for producing a large flame of high illuminating power, and I devised this form of burner. I used in its construction double jets, by which a more effective combustion of gas is attained with less consumption for each jet than in the burners which I used in my earlier experiments. The principle of the double jet is not new, but I believe that the present form of its application is entirely so. It is exceedingly simple, and may be explained by an ordinary gas-burner.

It will be seen that the power of this burner is obtained by a peculiar arrangement of numerous fishtail jets, and it is increased by suspending over the flame which they unitedly produce an oxidizer, of talc or other material, by means of which a current of air is brought in contact with its most smoky part, rendering it not only smokeless but exceedingly white. The combustion is also assisted by a bottom cone for equalizing the current of air to the flame. The oxygen of the air is thus twice availed of—first, at the bottom of the flame, through the medium of the several fishtail burners; and, secondly, at the top of it, where its action raises to a white heat the large quantity of solid carbon found there. This may be seen if I light a burner, which is one of the ordinary clear-weather lighthouse burners, and show it to you without and with its oxidizer. I may say, in passing, that burners like this are superior to any form of Argand burner in this important particular, that they require no chimney-glasses, the breaking and cleansing of which often cause much inconvenience in lighthouse maintenance, to say nothing of their presenting an obstruction to the passage of the light of the flame to the dioptric apparatus. I have on the table a complete Irish lighthouse burner. It is so constructed that a light-keeper can increase the power of the light by five steps, according as the state of the weather may seem to require it, from the burner used in clear weather, consisting of 28 jets such as I have just lighted (Fig. 3), to the second, third, fourth, and fifth fog powers, consisting of 48, 68, 88, and 108 jets respectively. The changes from one power to another can be made very quickly by the use of mercurial joints, as I shall now show you.

With respect to these fog burners at which we have just been looking, I may say that while we all know that there are fogs capable of obscuring any artificial light, and that even the sun's rays can but feebly penetrate dense fog, yet when fogs are not very dense, or when the weather is merely what is called "thick" (but sufficiently so to obscure ordinary lights), then it is that the mariner derives much benefit from powerful lights such as I have just shown you.

The power of the gas-burner at which we have just been looking is, of course, very much increased by the use of lenticular apparatus. I have here what is termed an annular lens of the kind used for revolving or flashing lights in first-order lighthouses. I will move it in front of the 28-jet burner. You will see how a beam the full size of the lens is made to traverse every part of the horizon.

If, instead of using this ordinary lighthouse lens, which is designed for an oil-lamp flame 4 inches in diameter by 3½ inches high, I were to use a lens made to suit my large 108-jet gas-flame (Figs. 2 and 4), which is 12 inches in diameter by 8½ inches high, I need not say that the illuminating effect would be enormously greater. I trust that before long lighthouse authorities will sanction the construction of such lenses, and so gain the full benefit of the large flames which, so far as we know, gas only can produce.

Being fully convinced, from long practical observation, of the importance of using large lights to illuminate fog, I determined to push that principle to the utmost limit permitted by the lenses now used in the lighthouses, and I devised a plan by which, in foggy weather, double, treble, and quadruple the power of the largest gas light and lens at which we have been looking can be obtained. This plan, which has been termed the biform, triform, and quadriform system, consists in placing two, three, and four burners respectively vertically over one another, and making an arrangement by which the products of the combustion of the lower burners are intercepted and turned outward, so as not to interfere with the upper burners, while a supply of pure air is conveyed to each of them by cylindrical openings brought through the flues. The air thus introduced is sucked in briskly by the draught and much heated by its contact with the nearly red-hot casing of the internal flue. The illuminating power of each of the flames is thus materially increased.

That you may clearly understand the plan by which these lights are burned one above another, I have here arranged two such lights, and you will observe that so far from the upper being injuriously affected by the lower light, it is improved by the high temperature at which it is burned, and the constant supply of fresh air which is sucked in by the apparatus which I have described. Without this apparatus, you will see that the upper light has hardly any illuminating power.

I have here a model of the quadriform apparatus which I have erected at Galley Head. There are 32 lenses arranged in four tiers, eight in each tier. Each lens is of the size of this first-order lens, and one of these powerful gas lights is placed in the focus of each tier. Thus there are four burners placed over each other. As the lenses touch each other the lights blend at a few yards distance, and form a great pillar of light about 13 feet high by 3 feet wide, the illuminating power of which is calculated to be equal to nearly a million sperm candles. This great illuminating power, it is to be remembered, is so under the control of the light-keeper, that only one-fourth of it is applied in clear weather, the other three portions being reserved for application as the weather thickens. This light is the largest in the world, and it ought to be a source of satisfaction to the Commissioners of Irish Lights to know that what they have done at Galley Head, in furtherance of the benevolent work to which they gratuitously give so much anxious attention, is likely to be of much benefit to the sailor. Indeed, since the completion of Galley Head Lighthouse early this year, the Commissioners have received from the commanders of the great ocean steamers which pass Galley Head the most satisfactory testimonials as to its power and distinctiveness. Can it be believed that there are persons who have expressed doubts whether the illuminating power of the quadriform is any greater than that of *one* of its four component lights? To convince such skeptics, and to afford the members of the British Association an opportunity of judging of the effect of this light, a first-order quadriform apparatus will, by the kind permission of the Commissioners of Irish Lights, be exhibited in comparison with the ordinary light at Howth Bailey Lighthouse.

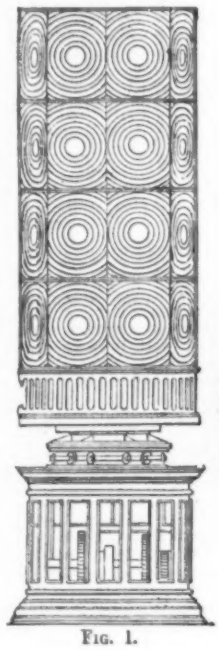


Fig. 1.

Fig. 2.

Fig. 3.

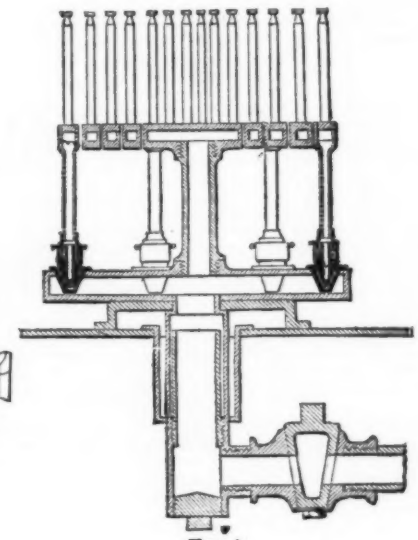


Fig. 4.

IMPROVEMENTS IN LIGHTHOUSE ILLUMINATION.

Before concluding, I should say that the light at Galley Head, besides being quadriform, is also what I have termed a "group-flashing" light—that is, the flashes from the lenses, instead of being single flashes, as usually exhibited at lighthouses, are each of them, by the continual extinction and reignition of the gas, broken up into four or five beams, which constitute a group of flashes recurring at regular intervals, thus presenting a very distinctive light for the guidance of the mariner. This is accomplished by the same clockwork machine by which the lenses are caused to revolve. The interval between the groups of flashes is one minute, the interval between the flashes composing each group is about two seconds, during which the gas is cut off; a very considerable economy in the maintenance of the lighthouse is the result, only about one-half the gas which would be used in ordinary flashing light being consumed.

One word more as to these flashes. Just as the suddenness of the flash of a gun catches the eye, so the effect on the fog when large gas-burners, such as I have described, are *suddenly* lighted, is very striking; and the use of gas as an intermittent light for lighthouse purposes is valued, not only because of its economy (the intermission being due to the cutting off and consequent saving of the gas), but also because of the illuminating effect on fog by the sudden exhibition of its great light, as I have just mentioned.

THE COMBINED GAS AND ELECTRIC LIGHT FOR LIGHTHOUSES.

The dimensions of the usual lanterns and dioptric apparatus of lighthouses not permitting us to use gas lights of a larger size than that which I have just described, and of which I have shown you a full-sized drawing, it seemed desirable to consider whether we could not usefully add still greater intensity to our lighthouse gas-flames than that obtainable from gas only. All our intense lights, such as the lime light, the electric light, magnesium light, etc., are costly;

but it occurred to me that if I could add some such intense light to my large gas-burners, so arranged that it need not be used except in thick weather, I would, at comparatively small expense, produce a fog light combining both quantity and great intensity. I made many experiments, and at length arranged for what I termed a core for my gas-burners. Any of the intense lights I have mentioned might form this core. I first used, as the simplest and least expensive, a rich hydro-carbon flame intensified by oxygen, but I prefer the electric light because of its greater intensity, and because of the facility with which, owing to the recent improvements in the Gramme magneto-electric machine, it can be applied. When the Jablochkoff electric candle, which is now so much used in Paris, has been so constructed that it may be burned without variation for many hours together, it may be very easily utilized for the core of which we have been speaking; but, in the meantime, the light from carbon points regulated by a Serrin lamp is quite available for that purpose. By a simple alteration in the arms which hold the carbons, and of the clockwork by which those arms are moved, we can bring the light into the precise focus of the gas-burner, and apply it in a moment when occasion arises. By means of a gas-engine, which, of course, can be used at all gas stations, it can be applied in a moment. With respect to this light, I will ask you to remember that its application is simply intended to add intensity to a large fog light, and that it is only designed to be used during fogs, so that no expense is incurred except while the fog lasts, and during that time it appears to me that *no* expense should be considered too great when the possibility of saving human life is taken into account. By the kindness of the Commissioners of Irish Lights, one of these combined lights will be fixed at Howth Bailey Lighthouse, and an opportunity will be afforded to the members of the British Association of judging of its effect in connection with the great quadriform light which, as I before mentioned, will also be placed in the experiment house of that station. I have read the programme of this Association at Salthill by the light transmitted from this combined light at Howth Bailey Lighthouse, about six miles distant—a test of the power of a lighthouse light more severe than has ever before been applied, so far as I am aware.

I will only add that what I have said in the early part of this paper, respecting the useful effect of sudden flashes, in catching the eye of the sailor by what may be termed a momentary thrill in fogs and haze, peculiarly applies to this combined gas and electric light; this light when suddenly exhibited produces an exceedingly striking effect, well calculated to arrest the attention of the mariner.

A MODE OF LIGHTING SEA BEACONS FROM A POSITION ON SHORE.

When it is desired to establish and maintain lights upon beacons where space is limited, and to which access by boat is difficult or expensive, gas properly dried by chloride of calcium may be very conveniently applied as the means of illumination. A gas station on shore will command any desired number of beacons, and the lights may be simultaneously lighted and extinguished from the shore. The plan I have adopted, and exhibited in operation to the Commissioners of Irish Lights, is very simple. During the daytime the gas is supplied at a pressure, say, equal to a column of water 6 inches high, to maintain a small light about the size of a pea in the lantern of each beacon. The gas for this light is driven through a by-pass in the valve of an automatic gas governor of suitable size fixed on each burner, and the high pressure at which the gas is supplied prevents wind or any slight movement of the supply-pipe from causing the extinction of the small flame, which thus remains as the permanent lamplighter of the beacon.

I will illustrate the tenacity of small flames burning at very high pressure by this simple experiment. I will supply a small flame with gas at 6 inches pressure of water, and then at 1 inch pressure. It will be seen that the least motion of the supply-pipe will extinguish it in the latter case, while it is comparatively difficult, if not impossible, by that means to extinguish it in the former case. At nightfall, when the time arrives for exhibiting the light in the beacon, the pressure at the shore station is diminished from 6 inches to, say, 1 inch, and this reduction of pressure immediately acts upon the governors which are attached to each light, causing their valves to open, and thus admit gas for a full-sized flame.

When the beacon light requires to be extinguished, the reverse process is gone through, the pressure on shore is increased, the governor-valve rises and extinguishes the light, leaving, however, the small by-pass pea-sized flame ready for the performance of its function as a lamplighter on the next occasion.

The little apparatus which I have here will clearly illustrate this method of illuminating beacons. I will put it into action. You will see that to light and extinguish the light at the opposite side of the room I simply reverse the ordinary plan to which we are accustomed. I turn off this cock to cause the lights to spring up, and I turn it on to extinguish the light.

TEMPERATURE OF FLAME.

By F. ROSSETTI (*Gazzetta Chimica Italiana*).

WHEN a gas flame is used, and the pressure of the gas is varied, the temperature increases but very slightly with the pressure for the same part of the flame (not more than 20°), although the size of the flame may vary greatly.

1. *Luminous Gas Flame.*—The flame of a Bunsen burner of which the air holes are closed, consists of an obscure internal nucleus and an outer luminous envelope, which at the lower part is surrounded by an external zone of a pale blue color. The internal cone has a temperature of 280° at its base, which gradually increases toward the apex, where it is the same as that of the luminous envelope; this is sensibly constant and about 1050°; the blue portion has a temperature of about 1300°.

In the ordinary fish-tail or bat's-wing burner the edges of the flame are about 1100°, and in the most luminous part 1150°.

2. *Non-luminous Flame.*—The temperature of the different layers in a Bunsen flame are slightly different from those given in the former paper, namely, 1360° for the external layer, and 1263° for the violet colored layer immediately beneath this.

3. In Bunsen's apparatus for showing the absorption of the yellow sodium light by sodium vapor, two flames are employed, the one having a much higher temperature than the other; these were found to be 940° and 1290° respectively.

4. *Flame of a Stearin Candle.*—The blue zone at the lower part of the flame is about 770°; the interior obscure cone 640° at the summit of the wick, and 840° at the apex; the external luminous envelope has a temperature of about 940°.

5. *Flame of a Locatelli Lamp.*—At the base of the flame, just above the wick, the temperature is 575°; the apex of the internal obscure cone, 875°; the luminous envelope at the same level, 890°; apex of luminous envelope, 920°.

6. *Flame of a Petroleum Lamp.*—This flame, with a chimney, has a temperature of 1030° in the luminous part; without a chimney, 780° in the smoky part; 920° in the most luminous part.

7. *Alcohol Flame.*—The temperature of this flame varies from 900° at the base to 1180° at the apex. The proportion of water present, within certain limits (sp. gr. of alcohol 0·912 and 0·8225), does not materially influence the temperature.

8. *Mixture of Gas and Air.*—Such a mixture in known proportions was burned in a Bunsen lamp, the air holes being closed. I gives the temperature obtained with equal volumes of gas and air; II, one vol. gas to two of air; III, one vol. gas to two and a half of air; IV, one vol. gas to three of air.

	I.	II.	III.	IV.
Apex of flame... ...	1150°	1260°	1150°	1116°
Base of internal cone.	570	330	270	240

A mixture of one vol. gas to four of air could not be burned in a Bunsen lamp, but with an ordinary steatite burner it gave a temperature of 930°. It will be seen that the highest temperature was obtained with a mixture of two vols. air to one of gas; the mixture in a Bunsen burner, under ordinary conditions, was found to be in the proportion 2·2 : 1.

9. *Mixture of Gas and Nitrogen.*—The conditions of experiment were the same as those in 8. I gives the temperature at the apex of the luminous flame; II, that at the base of the internal cone.

	I.	II.
Gas to nitrogen — 2 : 3	1240°	345°
" 1 : 1	1180	260
" 1 : 2	1150	240
" 1 : 2·5	1080	"
" 1 : 3	1040	210
" 1 : 4	960	160

When the proportion of nitrogen to gas exceeds 2 : 1, the flame is no longer luminous.

10. *Mixture of Gas and Carbonic Anhydride.*—With this mixture the space intervening between the flame and the top of the burner is distinctly marked: I and II have the same signification as in 9.

	I.	II.
Gas to carbonic anhydride — 2 : 1	1190°	280°
" " 3 : 2	1170	270
" " 1 : 1	1100	270
" " 2 : 3	1020	270
" " 1 : 2	880	"
" " 1 : 3	780	250

A comparison of the results in 9 and 10 shows that for equal volumes, carbonic anhydride has a more powerful cooling effect on the flame than nitrogen; this is in accordance with the specific heats of the two gases, which are in the proportion of 100 : 71.

The author also describes an electric pyrometer of carbon and platinum for temperatures up to 2000°, but it is not yet perfected.

THE ELECTRO-MAGNET A RECEIVING TELEPHONE.*

THE result I have arrived at while experimenting in this direction seems so interesting, and at the same time, I believe, novel, viz., *that a good receiving telephone can be made from electro-magnets alone without any vibrating diaphragm*, that I hope by prior publication, to prevent the possibility of a string of those patents which nowadays so greatly hamper true scientific invention.

In my earlier experiments I made an electro-magnet out of a piece of ¾ inch iron gas pipe, ¾ inch long, filed flat on one side, and split sufficiently only to allow the wire (No. 24) to be wound on, which was done till it was full inside. The poles were therefore together about ¾ inch square. This was fixed inside a small cigar box, under a ferrotype plate, covering a rectangular hole cut in the lid, 2¼ inches by 1½ inch. With a Hughes carbon-pencil-microphone tilted to an angle of 45° as a transmitter, a small musical box as a source of sound, in a distant part of the house, and one of Leclanché's cells in circuit, the box gave out tunes plainly heard by all sitting in the room.

While experimenting with another similar magnet, I stood it loose, poles downward, but still connected with the line wires on a flat tin gunpowder canister with the ends cut off, but still retaining the paper label on which the magnet lay; the tune of the musical box was given out loudly and resonant, but buzzing and jangling; also words spoken to the transmitter were heard, but confused together.

Now this was a very interesting result, which led to the next discovery, for, having a small ordinary electro-magnet, with its armature in front (as used in electric bells), fixed to a piece of board, I was about to unship it to try experiments in various tin cans, etc., when it occurred to me to connect it as it was, to the line wires, placing only a slip of paper between the poles and armature to prevent actual contact. To my astonishment, on putting the ear close to the board at any part, the music of the box was heard clearly, every note from highest to lowest being distinctly given. Now here seemed to be a telephone without a vibrating diaphragm; but, to make more sure, the armature was unscrewed from its support and attached to the magnet only by an India-rubber band, with the slip of paper between it and the poles, so that it touched no other part of the apparatus. On listening to the supporting board, the sounds were heard as distinctly as before.

But even here forensic ingenuity might claim and attempt to prove that this ordinary armature was a vibrating diaphragm; therefore, an armature being itself nothing but an induced magnet, it was replaced by another electro-magnet, thus:

Two ordinary electro-magnets (unscrewed from a couple of large electric bells) were fastened, by means of two little wooden saddles and a screw each, to a small piece of deal board about 4½ inches square and ⅝ inch thick, in such a way that the poles were all but touching. Their wires were then joined so that poles of opposite denominations faced each other, *i. e.*, north opposite south and *vice versa*. This placed on an empty cigar box and four Leclanché cells in circuit, gave out the tune of the musical box clearly and loudly in the room. When both the poles were made to touch, the sound ceased; but with a thin piece of paper or stout tinfoil between them, without any intervening air space, the sound was heard. On gradually separating the magnets, the sounds grew fainter and fainter till they became inaudible.

By putting the base-board close to the ear, whistling and singing to the microphone were very clearly and loudly heard, also the voice of the person speaking could be recognized; but words were hardly sufficiently defined to distinguish all that was said, though now and then parts were intelligible.

One of the electro-magnets was afterward replaced by a small permanent steel horse-shoe magnet fastened to the board in a similar manner; the result was the same, but, I imagined, slightly louder, probably from there being less resistance.

By varying the strength of battery, size, or mode of mounting magnets, or adjustment of the microphone, I have no doubt that perfect definition can be obtained. The loudness and volume of the sound are ample; but before making further experiments, for which I have at present little time, I hasten to communicate the *fact* that *the electro-magnet, without any diaphragm whatever*, can be made a reproducer of sounds transmitted by a Hughes microphone, and thus *a complete and practical telephone system produced without the possibility of infringing anybody's patent.*

I must add that the same arrangement is also a feeble transmitter, using a good Bell's telephone as a receiver, which is a very strange fact. I abstain at present from all theory on the subject.

F. G. LLOYD.

Nature.

THE PROVINCE OF MATHEMATICS.*

IT is as the supreme result of all experience, the framework in which all the varied manifestations of nature have been set, that our science has laid claim to be the arbiter of all knowledge. She does not indeed contribute elements of fact, which must be sought elsewhere; but she sifts and regulates them; she proclaims the laws to which they must conform if those elements are to issue in precise results. From the data of a problem she can infallibly extract all possible consequences, whether they be those first sought or others not anticipated; but she can introduce nothing which was not latent in the original statement. Mathematics cannot tell us whether there be or be not limits to time or space; but to her they are both of definite extent, and this in a sense which neither affirms nor denies that they are either infinite or finite. Mathematics cannot tell us whether matter be continuous or discrete in its structure; but to her it is indifferent whether it be one or the other, and her conclusions are independent of either particular hypothesis. Mathematics can tell us nothing of the origin of matter, of its creation, or its annihilation; she deals only with it in a state of existence; but within that state its mode of existence may vary from our most elementary conception to our most complex experience. Mathematics can tell us nothing beyond the problems which she specifically undertakes; she will carry them to their limit, but there she stops, and upon the great region beyond which she is imperturbably silent.

Conterminous with space and coeval with time is the kingdom of mathematics; within this range her dominion is supreme; otherwise than according to her order nothing can exist; in contradiction to her laws nothing takes place. On her mysterious scroll is to be found written, for those who can read it, that which has been, that which is, and that which is to come. Everything material which is the subject of knowledge has number, order, or position; and these are her first outlines for a sketch of the universe. If our more feeble hands cannot follow out the details, still her part has been drawn with an unerring pen, and her work cannot be gainsaid. So wide is the range of mathematical science, so indefinitely may it extend beyond our actual powers of manipulation, that at some moments we are inclined to fall down with even more than reverence before her majestic presence. But so strictly limited are her promises and powers, about so much that we might wish to know does she offer no information whatever, that at other moments we are fain to call her results but a vain thing, and to reject them as a stone when we had asked for bread. If one aspect of the subject encourages our hopes, so does the other tend to chasten our desires; and he is perhaps the wisest, and in the long run the happiest among his fellows, who has learned not only mathematics, but also the larger lesson which they indirectly teach, namely, to temper our aspirations to that which is possible, to moderate our desires to that which is attainable, to restrict our hopes to that of which accomplishment, if not immediately practicable, is at least distinctly within the range of conception. That which is at present beyond our ken may, at some period and in some manner as yet unknown to us, fall within our grasp; but our science teaches us, while ever yearning with Goethe for "Light, more light," to concentrate our attention upon that of which our powers are capable, and contentedly to leave for future experience the solution of problems to which we can at present say neither yea nor nay.

It is within the region thus indicated that knowledge in the true sense of the word is to be sought. Other modes of influence there are in society and in individual life, other forms of energy besides that of intellect. There is the potential energy of sympathy, the actual energy of work; there are the vicissitudes of life, the diversity of circumstance, health, and disease, and all the perplexing issues, whether for good or for evil, of impulse and of passion. But although the book of life cannot at present be read by the light of science alone, nor the wayfarers be satisfied by the few loaves of knowledge now in our hands, yet it would be difficult to overstate the almost miraculous increase which may be produced by a liberal distribution of what we already have, and by a restriction of our cravings within the limits of possibility.

In proportion as method is better than impulse, deliberate purpose than erratic action, the clear glow of sunshine than irregular reflection, and definite utterances than an uncertain sound; in proportion as knowledge is better than surmise, proof than opinion; in that proportion will the mathematician value a discrimination between the certain and the uncertain, and a just estimate of the issues which depend upon one motive power or the other. While, on the one hand, he accords to his neighbors full liberty to regard the unknown in whatever way they are led by the noblest powers that they possess, so on the other he claims an equal right to draw a

* From President Spottiswoode's Inaugural Address before the British Association.

clear line of demarkation between that which is a matter of knowledge and that which is at all events something else, and to treat the one category as fairly claiming our assent, the other as open to further evidence. And yet, when he sees around him those whose aspirations are so fair, whose impulses so strong, whose receptive faculties so sensitive, as to give objective reality to what is often but a reflex from themselves, or a projected image of their own experience, he will be willing to admit that there are influences which he cannot as yet either fathom or measure, but whose operation he must recognize among the facts of our existence.

MANIFOLD SPACE.*

Our whole experience of space is in three dimensions, viz., of that which has length, breadth, and thickness; and if, for certain purposes, we restrict our ideas to two dimensions, as in plane geometry, or to one dimension, as in the division of a straight line, we do this only by consciously and of deliberate purpose setting aside, but not annihilating, the remaining one or two dimensions. Negation, as Hegel has justly remarked, implies that which is negatived, or, as he expresses it, affirms the opposite. It is by abstraction from previous experience, by a limitation of its results, and not by any independent process, that we arrive at the idea of space whose dimensions are less than three.

It is doubtless on this account that problems in plane geometry, which, although capable of solution on their own account, become much more intelligible, more easy of extension, if viewed in connection with solid space, and as special cases of corresponding problems in solid geometry. So eminently is this the case that the very language of the more general method often leads us almost intuitively to conclusions which, from the more restricted point of view, require long and laborious proof. Such a change in the base of operations has, in fact, been successfully made in geometry of two dimensions, and although we have not the same experimental data for the further steps, yet neither the modes of reasoning nor the validity of its conclusions are in any way affected by applying an analogous mental process to geometry of three dimensions, and by regarding figures in space of three dimensions as sections of figures in space of four in the same way that figures in plano are sometimes considered as sections of figures in solid space. The addition of a fourth dimension to space not only extends the actual properties of geometical figures, but it also adds new properties which are often useful for the purposes of transformation or of proof. Thus it has recently been shown that in four dimensions a closed material shell could be turned inside out,† by simple flexure, without either stretching or tearing,‡ and that in such a space it is impossible to tie a knot.

Again, the solution of problems in geometry is often effected by means of algebra: and as three measurements, or co-ordinates, as they are called, determine the position of a point in space, so do three letters or measurable quantities serve for the same purpose in the language of algebra. Now many algebraical problems, involving three unknown or variable quantities, admit of being generalized so as to give problems involving many such quantities. And as, on the one hand, to every algebraical problem involving unknown quantities or variables by ones, or by twos, or by threes, there corresponds a problem in geometry of one or of two or of three dimensions, so on the other it may be said that to every algebraical problem involving many variables there corresponds a problem in geometry of many dimensions.

There is, however, another aspect under which even ordinary space presents to us a fourfold, or, indeed, a manifold character. In modern physics space is not regarded as a vacuum in which bodies are placed and forces have play, but rather as a plenum with which matter is co-extensive. And from a physical point of view the properties of space are the properties of matter, or of the medium which fills it. Similarly, from a mathematical point of view, space may be regarded as a *locus in quo*, as a plenum, filled with those elements of geometrical magnitude which we take as fundamental. These elements need not always be the same. For different purposes different elements may be chosen; and upon the degree of complexity of the subject of our choice will depend the internal structure or manifoldness of space.

Thus, beginning with the simplest case, a point may have any singly infinite multitude of positions in a line, which gives a onefold system of points in a line. The line may revolve in a plane about any one of its points, giving a twofold system of points in a plane; and the plane may revolve about any one of the lines, giving a threefold system of points in space.

Suppose, however, that we take a straight line as our element, and conceive space as filled with such lines. This will be the case if we take two planes, *e.g.*, two parallel planes, and join every point in one with every point in the other. Now the points in a plane form a twofold system, and it therefore follows that the system of lines is fourfold; in other words, space regarded as a plenum of lines is fourfold. The same result follows from the consideration that the lines in a plane, and the planes through a point, are each twofold.

Again, if we take a sphere as our element we can through any point as a center draw a singly infinite number of spheres, but the number of such centers is triply infinite; hence space as a plenum of spheres is fourfold. And generally, space as a plenum of surfaces has a manifoldness equal to the number of constants required to determine the surface. Although it would be beyond our purpose to attempt to pursue the subject further, it should not pass unnoticed that the identity in the fourfold character of space, as derived on the one hand from a system of straight lines, and on the other from a system of spheres, is intimately connected with the principles established by Sophus Lie in his researches on the correlation of these figures.

If we take a circle as our element we can around any point in a plane as a center draw a singly infinite system of circles; but the number of such centers in a plane is doubly infinite; hence the circles in a plane form a threefold system, and as the planes in space form a threefold system, it follows that space as a plenum of circles is sixfold.

Again, if we take a circle as our element, we may regard it as a section either of a sphere or of a right cone (given except in position) by a plane perpendicular to the axis. In the former case the position of the center is threefold; the directions of the plane, like that of a pencil of lines perpendicular thereto, twofold, and the radius of the sphere onefold; sixfold in all. In the latter case the position of the vertex is threefold, the direction of the axis twofold, and the distance of the plane of section onefold, sixfold in all, as before. Hence space as a plenum of circles is sixfold.

Similarly, if we take a conic as our element, we may regard it as a section of a right cone (given except in position) by a plane. If the nature of the conic be defined, the plane of section will be inclined at a fixed angle to the axis; otherwise it will be free to take any inclination whatever. This being so, the position of the vertex will be threefold, the direction of the axis twofold, the distance of the plane of section from the vertex onefold, and the direction of that plane onefold if the conic be defined, twofold if it be not defined. Hence space as a plenum of definite conics will be sevenfold; as a plenum of conics in general, eightfold. And so on for curves of higher degrees.

This is, in fact, the whole story and mystery of manifold space. If not seriously regarded as a reality in the same sense as ordinary space, it is a mode of representation, or a method which, having served its purpose, vanishes from the scene. Like a rainbow, if we try to grasp it, it eludes our very touch; but, like a rainbow, it arises out of real conditions of known and tangible quantities, and, if rightly apprehended, it is a true and valuable expression of natural laws, and serves a definite purpose in the science of which it forms part.

* From President Spottiswoode's Inaugural Address before the British Association.

† S. Newcomb "On Certain Transformations of Surfaces," *American Journal of Mathematics*, vol. i., p. 1.

‡ Tait "On Knots," Transactions of the Royal Society of Edinburgh, vo. xxviii, p. 145. Klein, *Mathematische Annalen*, ix., p. 478.

MEASUREMENTS IN PHYSICS.

[From the inaugural address of President Spottiswoode, before the British Association.]

If it were my purpose, by descending into the arena of special sciences, to show how the most various investigations alike tend to issue in measurement, and to that extent to assume a mathematical phase, I should be embarrassed by the abundance of instances which might be adduced. I will therefore confine myself to a passing notice of a very few, selecting those which exemplify not only the general tendency, but also the special character of the measurements now particularly required, viz, that of minuteness, and the indirect method by which alone we can at present hope to approach them. An object having a diameter of an 80,000th of an inch is perhaps the smallest of which the microscope could give any well-defined representation; and it is improbable that one of 120,000th of an inch could be singly discerned with the highest powers at our command.* But the solar beams and the electric light reveal to us the presence of bodies far smaller than these. And, in the absence of any means of observing them singly, Prof Tyndall has suggested a scale of these minute objects in terms of the lengths of luminiferous waves. To this he was led, not by any attempt at individual measurement, but by taking account of them in the aggregate, and observing the tints which they scatter laterally when clustered in the form of actinic clouds. The small bodies with which experimental science has recently come into contact are not confined to gaseous molecules, but comprise also complete organisms; and the same philosopher has made a profound study of the momentous influence exerted by these minute organisms in the economy of life. And if, in view of their specific effects, whether deleterious or other, on human life, any qualitative classification or quantitative estimate be ever possible, it seems that it must be effected by some such method as that indicated above.

Again, to enumerate a few more instances of the measurement of minute quantities, there are the average distances of molecules from one another in various gases and at various pressures; the length of their free path, or range open for their motion without coming into collision; there are movements causing the pressures and differences of pressure under which Mr. Crookes' radiometers execute their wonderful revolutions There are the excursions of the air while transmitting notes of high pitch, which through the researches of Lord Rayleigh appear to be of a diminutiveness altogether unexpected. There are the molecular actions brought into play in the remarkable experiments by Dr. Ker, who has succeeded, where even Faraday failed, in effecting a visible rotation of the plane of polarization of light in its passage through electrified dielectrics, and on its reflection at the surface of a magnet. To take one more instance, which must be present to the minds of us all, there are the infinitesimal ripples of the vibrating plate in Mr. Graham Bell's most marvelous invention. Of the nodes and ventral segments in the plate of the telephone which actually converts sound into electricity and electricity into sound, we can at present form no conception. All that can now be said is that the most perfect specimens of Chladni's sand figures on a vibrating plate, or of Kundt's lycopodium heaps in a musical tube, or even Mr. Sedley Taylor's more delicate vortices in the films of the phoneidoscope, are rough and sketchy compared with these. For notwithstanding the fact that in the movements of the telephone-plate we have actually in our hand the solution of that old-world problem, the construction of a speaking-machine, yet the characters in which that solution is expressed are too small for our powers of decipherment. In movements such as these we seem to lose sight of the distinction, or perhaps we have unconsciously passed the boundary between massive and molecular motion.

Through the phonograph we have not only a transformation, but a permanent and tangible record of the mechanism of speech. But the differences upon which articulation (apart from loudness, pitch, and quality) depends appear from the experiments of Fleeming Jenkin and of others to be of microscopic size. The microphone affords another instance of the unexpected value of minute variations—in this case of electric currents; and it is remarkable that the gist of the instrument seems to lie in obtaining and perfecting that which electricians have hitherto most scrupulously avoided, viz., loose contact.

* See Sorby's Address to the Microscopical Society, 1876.

THE GEOGRAPHY OF NEWFOUNDLAND.

A correspondent of the New York *Tribune*, writing from St. Johns, N. F., says that the statistics given in geographies with regard to Newfoundland have been proved by the recent geological survey of that island to be very defective.

All, or nearly all, of the school books on geography place the area of the colony at 36,000 square miles. They are also faulty with regard to the length and breadth of the island According to the recent careful survey the area of this island is 42,000 square miles of land. It is 317 miles in length and 316 miles in breadth. It is, therefore, the tenth largest island in the world. It is one third larger than New Brunswick; more than twice the size of Nova Scotia; contains 10,000 square miles more than Ireland; 12,000 square miles more than Scotland; is three times as large as Holland, and twice as large as Denmark. Grand Lake, hitherto almost unknown, proves to have an area of 192 square miles, while Como, in Italy, has only 90 square miles, and the equally celebrated Killarney only 8 square miles. Gauder Lake, of which we knew nothing until the Royal Geographical Surveyor, Captain Murray, R.E., explored it, has an area of 44 square miles, and Red Indian Lake 69 square miles. In the world there is not an equal area with such an extent of coast line as Newfoundland, which, according to the surveyors' report, cannot be less than 2,000 miles in length. This is owing to the fact that the shores are indented with so many bays, arms and inlets of the sea, thus furnishing the most splendid facilities for commercial intercourse, and, at the same time, carrying the finny tribes far inland, within reach of the fisherman's hook and net.

Captain Murray has calculated that there are nearly 3,000,000 acres of land suitable for settlement on the eastern and western shores, all at present unoccupied. The fears that the main resource of the island, its fisheries, are becoming exhausted are shown to be quite unfounded. Within twelve years the value of codfish, the great staple of the island, has doubled, and with the aid of science the fisheries of Newfoundland are capable of indefinite expansion. The total number of vessels employed in catching and procuring fish in this colony is 1,200, with a tonnage of 61,551 tons, manned by 82,000 fisherman sailors. About forty years ago the bank fishing, so far as regards Newfoundland, entirely ceased, and the fishing has since been carried on altogether within shore, and is extending, year by year, further and further up Labrador. The way in which the Arctic current, which sweeps along these shores, sustains the fisheries is explained in Professor Hind's official report. He maintains that it is a popular error that the cold of the Arctic seas is unfavorable to fish life. In truth the Arctic seas and the great currents flowing from them are in many places a living mass, a vast ocean of living slime, and the all-pervading life which exists there affords the true solution of the problem which has so often presented itself—where the food comes from which gives sustenance to the millions of fish which swarm wherever the Arctic current exerts an active influence. This slime of the ocean appears to live most abundantly in the coldest water and the neighborhood of ice.

A NEW ENGLAND SILVER MINE.

Unquestionably a rich belt of ores bearing gold and silver has been developed at Sullivan, Hancock county, in the State of Maine, within twelve miles of the now fashionable pleasure resort of Mount Desert. This fact was made plain to us some ten days ago, when attracted by reports of the character of this mineral development to visit the place and by a personal examination to ascertain the precise character and probable extent of this newly found mineral field here in the East. Passing the greater part of three days at the mine, owned by the organization known as the Sullivan Mining Company, whose place of business is 252 Washington street, Boston, we found there a large shaft, sunk already more than sixty feet upon the vein, while about 100 tons of the ore were raised and ready for the market or treatment. We saw blasted and raised to the surface several tons of this ore, every fragment of which gave evidence of high value in the native silver and of brittle silver which it contained, as was also the case, notably, with every piece upon the ore dump which we examined at random. Lithologically the conditions for the presence of a true fissure-vein of the precious metals are entirely favorable.

The "country rock" in which this mine occurs is quartzitic slate, through which a ridge of granite has been upheaved along a line of some twenty miles. The silver veins of the district occur along the belt of slate near the granite. The contact of slate and granite, at the surface, is very irregular, owing to metamorphism and dikes. In the Sullivan mine the vein is parallel to and about 350 yards westerly from the granite belt, in the slates dipping about 40° from perpendicular, conformably with the slates, toward the granite. As far as this vein and its extensions have been traced southerly, the same applies. At the bottom of the shaft as we have said, now down somewhat over sixty feet, the vein is six feet wide—having widened one and a half feet in the last three feet of depth. The vein matter is found in lenticular masses, of three distinct varieties of gangue, namely:

1st. Quartz. This forms, as developed at the present bottom of the shaft, about three fifths of the vein, and carries a slight amount of galena, some zinc-blende, with much native silver in flakes, threads, and lumps. Also, notably, brittle silver sulphide.

2d. "Conglomerate," so-called, being a mixture of quartz with some black slaty matter in lumps, and carrying, in an eminent degree, flake silver and silver glance, thread silver rarely, antimonial silver frequently.

3d. "Blue slate ore," so-called, but more properly a blue quartzite, with slate matter included. This is a surprising ore, carrying highly in silver glance and flake silver (frosted silver), and frequently very rich in antimonial silver. Ruby silver, also, is found in this class of ore, but rarely. This is a vein of true silver ores, as distinguished from a galena vein, and has shown a very marked increase in amount of silver flakes and threads in the last twenty feet of depth.

Among the rare curiosities of this vein may be mentioned the mineral petzite (telluride of silver and gold), or at least a telluride which seems to correspond to this mineral. It occurs not only in this mine, but as far southerly as any openings have been made on extensions of the formation, notably at the shaft about three fourths of a mile south, called the "Millbrook."

Three miles to the north, on the other side of the river or bay, the line of formation strikes the shore, and here a shaft is being sunk on one of eight small veins, which appear to join below. The ore here, although of slight quantity, is of very good quality, being a copper sulphuret running high in silver, owing to a mixture of gray silver ore. This is the only opening made as yet north of the Sullivan mine.

South of the Sullivan, two shafts, the "Millbrook" and "Ashley," are being sunk. Here the vein is broken by heavy dikes between this and the Sullivan, and the principal ore found thus far in either is the telluride just mentioned. These are simply prospecting shafts.

It remains to be added that we shall, in our next issue, be able to give assays of an average character of the ore taken from the present bottom of the shaft of the Sullivan mine, made at the United States Assay Office in New York. Meanwhile, we may state that we have seen a report of a number of assays made by S. Dana Hays, assayer of the State of Massachusetts, giving an average of $232.87 to the ton.—*Mining Record.*

[Concluded from SUPPLEMENT No. 144, page 2284].

THE ART OF PRESERVING THE EYESIGHT.

Adapted from the French of ARTHUR CHEVALIER.

XI.—ADVICE RELATIVE TO THE HYGIENE OF THE EYES.

In this chapter we will speak of the care that should be taken in order to preserve the sight. If every one would pay a little more attention to his eyes, and not imagine that he can abuse them with impunity, the diseases of these precious organs would certainly be more rare, and we would not see so many persons whose eyesight is completely destroyed for want of care and attention. We will endeavor, then, to give some counsel on this subject, based on practical experience.

Every one knows the strength of his eyes, or, in other words, every one is capable of recognizing the fact as to whether his eyes are weak or strong, easily fatigued, or can bear without difficulty the effects of light, reading, etc. The exercise of sight should be regulated according to the strength of the eyes and their degree of health.

One of the most important hygienic precepts in regard to the sight is: *rest the eyes occasionally during work.* Thus in reading or writing one should suspend his occupation from time to time and allow his eyes to wander over surrounding objects. We cannot foresee the length of time that we are to be occupied with work, for this is subordinated to too many other things; but for weak eyes, one hour of labor divided into two intervals is the maximum that one ought to require of his sight. Moreover, as soon as the eyes begin to itch, or any redness appears, or any pain is felt in the eyeball, work should be at once discontinued, and the eyes bathed with cold water.

To persist in working when symptoms of fatigue make their appearance is another error into which people often fall. So we often find literary men, statesmen, clerks, and public officers, etc., continuing to work, even when they are warned by itching of the eyes and heaviness of the lids and headache that they are fighting against nature. Such obstinacy leads unhappily to amblyopy, amaurosis, and very often to myodopsy, a disease in which black spots apparently dance before the eyes. It is very easy to avoid all that by following the precepts that we have just given.

Young, blonde persons are very subject to a weeping of the eyes, and a redness and swelling of the eyelids whenever they work. When this takes place they should redouble their attention, and make use of spectacles with plane, lightly colored glasses.

Beer, whose ideas are very correct, expresses himself thus: "If a person cannot, on account of domestic affairs, tear himself away from close work, he can at least vary his occupation. Let him close his eyes from time to time, and take a turn around his room, or, what is better, take a walk in the fresh air; this, even if it be but for a few minutes only, will do him a great deal of good. Let him who once becomes convinced that he is putting too much confidence in his eyes take care to abstain from all confining work, immediately after rising, after meals, or by artificial light in the evening. Let him wash his eyes often during the day with cold water—a remedy which, although simple in itself, never fails in every case to produce good effects. I have already remarked that baths of tepid water are injurious to the eyes, and now I repeat it; it is only necessary to rinse them, for the act of washing produces a heat that is more than sufficient."

An important point in the preservation of the sight is not to pass suddenly from darkness into light, and *vice versa.* The bad effects of passing from light into darkness may often be observed. Who, for instance, after having extinguished a lamp, has not seen flashes of light before his eyes? This proves that an impression is made on the retina; and a powerful, lively impression, too, since it leaves such evident traces. The proper thing to do when coming out of a dark or badly lighted place is to try to accustom the eyes little by little to the light. Great precautions should also be taken on awakening in the morning. Many persons have the bad habit of rubbing their eyes on awakening; this should be avoided, since it irritates the eyelids, compresses the eyeballs, and often detaches the eyelashes, which, lodging between the sclerotic coat and conjunctiva, give rise to affections the cause of which is often sought for in vain. In the morning, if the eyelids are glued together, a little saliva should be rubbed on their edges, and the eyes will then open easily and without any bad effect following.

As a general thing bright lights should be avoided; the light given out from a sky covered with translucent clouds is best. It is bad for certain professions that they need a brilliant light; nothing is worse for the sight than engraving on metals, jewelry, etc. Merchants who are obliged to look at white linens nearly the whole day are often exposed to amblyopy; they ought necessarily to use pale tinted glasses.

Daylight alone is proper for the eyesight, its whiteness being perfectly adapted to the visual function. Artificial lights are very injurious to the eyes. Did we follow the example of nature, we would retire and arise with the sun, or at least make as little use as possible of artificial lights. It may be objected that, in winter, darkness comes on quickly: that in certain countries the light is not intense enough. In such cases, certainly, it is necessary to use artificial light; but it is none the less true that *white* light is the only kind suited to the eyes; in other words, the eye was made to see by the aid of white light, and not with the red or yellow furnished by artificial lights. Thanks to human progress, we are no longer reduced to the horrible candle and taper. The slimmest purse can now afford a mechanical lamp giving a fixed and equal light. In the evening, then, a good lamp should be made use of and candles totally banished. There is another thing that we cannot too strongly insist on, and that is the abuse of gas light. That this invention is admirable for lighting streets, theaters, and public places, we admit; but the way in which it is used in our apartments is detestable. In the first place, its lighting power is too intense, its color is yellow, and the light is not steady; then again, it gives out great heat, and its combustion being attended with the consumption of an enormous amount of oxygen, the surrounding air is rendered very unhealthy. We assert, then, that mechanical lamps, fed by an excellent quality of oil, constitute the best mode of lighting. In using lamps, care should be taken to sit in such a position that the rays of light which they shed may be received obliquely, and that their flames may not be seen. Lamps should always be provided with pale green or bluish paper shades. Figured shades should be studiously avoided.

Another important point: Many persons place the table on which they are writing or doing other work, at haphazard. Now there are several rules to be observed in regard to this subject. Thus, the best manner of receiving the light would naturally be from above, but as that is rarely possible, it should always be received from the left. The workroom should always be to the north, in order to obtain the benefit of a diffused light. The walls should have a greenish tint, all gilding, and other reflecting surfaces, being banished.

Has the color of the eyes anything to do with their strength? Beer has remarked that brown eyes are stronger than gray or blue. M. Desmarres does not share this opinion. We believe that he is right. However, I have met with some facts which would tend to strengthen the view of Beer, but not enough to prove conclusive.

We insist on it that there is nothing worse for the sight than reading in a carriage, on the railroad, or in walking. The multiplied impressions made on the retina end by greatly fatiguing it. It should be remarked, too, that we should not sit too near the fire, and screens should be used to protect the head from the heat, otherwise we run the risk of becoming troubled with cataract.

The eyesight of aged persons demands much care. Dr. Magne gives the following hygienic directions: Make use of diluent food: take an hour's exercise after meals, do not take a nap after eating, keep the head from the action of the fire, proscribe alcoholic liquors, avoid all pleasures inconsistent with old age, do not sit up late, and, finally, live in the country. By this means, says the doctor, we may retard, if not prevent, the opacity of the crystalline lens.

Dr. Magne advises, if the sight diminishes (although there may be no opacity), frictions once or twice a day on the temples with the following liniment:

Aqua ammonia	2 drachms.
Tr. nux vomica	2 "
Tr. saffron	½ "
Ess. bergamot	½ "
Tr. lavender	1 "
Acetic ether	1 "

Use a teaspoonful for every friction.

Foreign bodies accidentally falling into the eye may give rise to great suffering. Small particles of wood, sand, etc., may, on raising or lowering the lids, be removed by means of a bit of rolled paper. The eye should then be frequently bathed with cold water. If it is a question of bits of metal, it will be necessary to have recourse to a physician, who will use a needle, as shown in Fig. 93, borrowed from a treatise on surgery by Dr. Guérin.

In conclusion we will say a few words as to the hygiene for the eyesight of children, which needs very close attention. Care should be taken to place their beds and cradles in such a way that the light may not reach and injure their eyes. If the bed is placed so as to face the window, the child, receiving the light in its eyes, may become afflicted with amaurosis; if the cradle is placed to one side, the child,

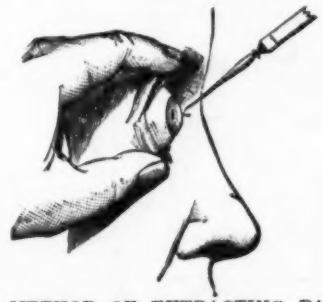


FIG. 93.—METHOD OF EXTRACTING PARTICLES OF METALS FROM THE EYE.

endeavoring to direct its eyes toward the light, may become squint-eyed. Another thing that may cause strabismus in children is the habit of allowing them to wear their hair long; this falling over their eyes and partially masking them is apt to give a false direction to vision. Children should not be allowed to rub their eyes; and especial care should be taken not to allow them to throw dust or sand at each other, as children often do, for particles of these substances getting into their eyes may cause the malady known as *ciliary blepharitis.* The edges of the lids become inflamed, the eyelashes turn inward, a secretion takes place, and it is then necessary to have recourse to therapeutical remedies. Dr. Magne, who has described these minor affections of childhood, advises us, in the case of this malady, to wash the eyes several times a day with cool water. If the eyelids are glued together in the morning they may be washed five or six times a day with the following collyrium:

Rosemary water	10 drachms.
Cherry-laurel water	10 "
Rose water	10 "
Lapis divinus	12 "
Mix and filter, then add	
Tr. of cinchona	15 drops.

At night a little "Regent's Pomade" should be spread over the whole surface of the eyelids. The Regent's Pomade is composed of red precipitate, alum and camphor made into an ointment with lard. Of course it will be understood that children should not be allowed to sit up late, for artificial light greatly injures their eyes, which as yet have not acquired sufficient strength. It may be asserted without fear of contradiction, that the majority of visual maladies which afflict old age result from the carelessness of parents in regard to their children when very young.

Just here we will make some remarks on the subject of eye-washes (*collyria*), and state how they should be used. We will also give the names of some of the substances which enter into their composition, not in order to prescribe the use of them, but to interest our readers. Eye-washes come within the domain of the physician, so we will not permit ourself to give any advice in regard to them. But for weak eyes, we believe we are justified in recommending a simple remedy that we have found excellent in our own case, and that is a weak infusion of black tea, which is to be used cold, the eyes being bathed with it morning and evening. In regard to eye-washes Dr. Desmarres, a high authority, says: "Experience has taught us that simple fomentations, with the weakest collyria, applied to the eye with a rag or sponge, are of great utility, but the organ should never be bathed with those little vessels called eye-cups. The contact of the medicine by this means is too direct and too prolonged, and, unless the wash be excessively weak, the effects will be entirely different from those anticipated. The materials most usually employed in collyria are: Nitrate of silver, sulphate of zinc, acetate of copper, sulphate of copper, acetate of lead, alum, borax, and sulphate of atropia. Lapis divinus is also much used in either the solid or liquid state for cauterizing. This compound is obtained by melting together equal parts of the following: Sulphate of copper, niter, alum, and a little camphor. Pomades or ointments are prepared with the several substances already mentioned. There are many proprietary articles in favor with the public, but nearly all have for a base, red precipitate or red oxide of mercury."

The affections of the eyes which arise from a general debility of the system should be the object of the most scrupulous attention. Their treatment belongs exclusively to the medical art, a science which, at the present day, has very celebrated representatives. Those persons, therefore, who, having trouble with their eyesight, do not betake themselves to a good physician for treatment, are merely trifling with the most important sense that they possess.

In conclusion we will remark that there is a host of persons who, having perfectly healthy eyes, are yet madly endeavoring to lose their sight by using collyria or pretended remedies obtained from quacks. Let it be known, then, once for all, that healthy eyes demand no other remedy than that of being washed every morning with pure water. Washing the face suffices for the eyes, a special washing of the latter being unnecessary; and, moreover, no addition to the water can be made with any profit to the sight. By avoiding charlatans, then, and following the precepts that we have given, it will be possible for any one to *preserve* his *eyesight* for an indefinite period.

REUNION AND RESTORATION OF DIVIDED NERVES.

NEITHER, so far as the limbs are concerned, do the muscles, the bones, or the joints mark the limit of our recent surgical acquisitions. In the *Lancet* of June 1st, of the present year, a series of experiments are recorded as in progress in Germany, the object of which is to ascertain whether the nerves, like other structures, are not amenable to surgical treatment for their restoration after division and complete loss of function; but, while the Germans are patiently experimenting to determine the point, it is my good fortune to be able to answer this question distinctly in the affirmative, as the following case will show:

On May 5th, 1875, a patient named Adam Smith, a laborer, aged 23, entered the Infirmary at Leeds, under my care. He limped into the ward on crutches, his left lower limb being completely paralyzed and useless, and stated that he had come to request us to remove it, as an incumbrance. The story he told me concerning it was this: Nine months previously, as he was returning home one evening, at the close of his day's labor, carrying his scythe over his shoulder, being anxious to make a short cut to his cottage, he attempted to climb over a fence; in doing this, the point of his scythe caught in the hedge behind him; he was jerked suddenly backward, and fell with the back of his thigh upon the sharp edge of his implement. The result of this was a ghastly wound, the contracted cicatrix of which measured nine inches in length when I first saw it, nine months afterward. He lay, bleeding profusely, where he fell, for many hours, before he was found and carried home; there the hemorrhage was staunched, the wound was dressed, and, in process of time, it slowly healed; but he noticed, during the whole time so occupied, that the limb was slowly wasting and withering away, and that it manifested no sign whatever of any returning sensibility.

Eventually, when he was able to leave his bed, he found to his horror that, although the wound was healed, and the limb was apparently saved, it had become wholly useless to him. So far as the distribution of the sciatic nerve was concerned, the power of sensation was entirely lost; of voluntary muscular power he had none, and the joints were relaxed and flaccid.

I need not detail to you all the efforts, vain efforts indeed, that he made to recover the lost powers of the limb; suffice it to say that, receiving no benefit from anything he did or tried, he finally came to the hospital to ask for its removal.

The whole cause of the mischief was, of course, clear at a glance. The sciatic nerve had been divided, and in the healing of the wound the separated ends had never reunited. Here, if ever, was a fair opportunity to test the question: Are nerves which have been divided, and have for long remained disunited, capable of restoration?

I called my colleagues to my assistance in forming an opinion on the matter. Dr. Clifford Allbutt was good enough most patiently and carefully to test electrically the condition of the disused and wasted muscles, and he reported that, though not wholly destroyed, their irritability was well-nigh exhausted. My surgical colleagues agreed with me that whereas, should the attempt to restore the lost nerve-power altogether fail, I could still, as a last resource, remove the limb, I should be justified in making an attempt to reunite the ends of the divided nerve. After fully explaining to the patient the position of affairs, and obtaining his assent, I determined to do so.

Having laid open the back of the thigh, and, by a careful and deliberate dissection of the parts, exposed the wounded nerve, I found it completely cut across; the two ends were firmly felted in cicatricial tissue two inches apart. On the upper one was a large bulbous swelling; the lower appeared atrophied and somewhat wasted; both were carefully loosened and detached; the bulb was removed from the upper one, and each was then pared obliquely until apparently fresh nerve tissue was exposed. When I then attempted to bring them together, the nerve was found to be so much shortened that I could not do so until I flexed the knee fully. This enabled me to make the ends of the nerve meet without strain; they were then carefully stitched together with very fine carbolized catgut thread, the wound was closed, the ankle was firmly lashed to the buttock, and in this position the patient was put to bed.

I will not weary you with details. Suffice it to say that little by little, and in very wandering fashion, day by day, and week after week, sensation was found to be returning to the limb. At the end of five weeks I began slowly to relax the position and let down the leg inch by inch, until at length it became straight again, and then, to my intense satisfaction, I found that the restored sensibility remained. By very slow degrees the power of voluntary motion also returned, and on August 7th he was discharged from the hospital so far cured that, with the help of two sticks, he was able to support himself on the limb and could walk. From that time to this he has gone on improving.

Since the performance of that operation, my colleague, Mr. Atkinson, has in similar manner successfully reunited a divided median, and Mr. Jessop has reminded me that, long prior to my case, he also had been equally happy in thus dealing with an ulnar nerve.—C. G. WHEELHOUSE, *in Brit. Med. Journal.*

GASTROTOMY IN STRICTURE OF THE ŒSOPHAGUS.

WITH REPORT OF A SUCCESSFUL CASE BY PROFESSOR F. TRENDELENBURG, OF ROSTOCK.

By W. Thomson, M.D.

Our object in publishing cases should be to demonstrate something tending to the good of the human family; and although we may traverse the same ground which others have traversed, there is work still left, and our labors with this object in view will never be unrewarded.

With the exception of Mr. Sidney Jones' case, which survived the operation forty-one days, M. Verneuil, of Paris, has been the only surgeon fortunate enough to have permanent benefit follow the operation of gastrotomy. It therefore affords me much pleasure to be able to give particulars of another case not before published in this country.

Gastrotomy performed for the purpose of constructing a fistula in the stomach in cases of œsophagus-stenosis has, it is well known, been hitherto followed by such strikingly unfavorable results because the operation has always been carried out as the final attempt with carcinomatous patients, whose eventual death was inevitable. Since the introduction of the antiseptic method the danger of intervening peritonitis has been shown to be comparatively small. In fifteen cases instanced by Jacobi,* two died from ulcerated peritoneum, and in the case of two others it remained doubtful whether death was the result of exhaustion or of incipient peritonitis. These data furnish, it is true, only an approximate measure of proportion, inasmuch as some of those operated upon died too soon after the operation to admit of their having been attacked by peritonitis, and it is also questionable whether there were not other cases which terminated unfavorably, and which have remained unpublished. If, however, the percentage of fatal cases from peritonitis ought to have been placed by Jacobi very much higher, it would have little bearing upon present opinion of the value of the operation; for since it has become known how important a part is played by septic processes in connection with the setting in of traumatic peritonitis, the prognosis of all operations on the abnominal cavity has become much better, and promises continually to improve.

The danger of such septic processes in gastrotomy is not, however, very great; and the operation in this particular stands about on a level with the construction of an artificial rectum and the sewing on of an ovarial or echino-coccuscystis to the wall of the stomach. It is not difficult to perform this operation without causing blood to flow into the abdomen, and, if no corrosive fluid be present, it will not easily lead to septic action even without the use of antiseptic precautions.

In one particular the circumstances attending gastrotomy are less favorable than those consequent on enterotomy—that is, in so far that in gastrotomy the stomach tries to draw itself away from the stomach wall, whereas in enterotomy the stretched and elastic intestine sets itself at the bend against the wall of the abdomen, so that the reclosing of the abdominal cavity takes place automatically through the adhesion of the intestine and the abdominal wall.

If vomiting occur after gastrotomy has been performed, the tension of the stomach may be so great that, if insufficiently nourished, it may tear itself away from the abdominal wall, as Sédillot and Cooper Forster experienced. In gastrotomy more depends, therefore, upon certainty of nourishment than in enterotomy.

Verneuil, in his case (the first which was attended with lasting results), applied a wreath of fourteen sutures of silver wire, and thinks there is a special advantage in the use of silver wire. To this, however, no great importance need be attached, for silk will do just as well. It cannot be supposed that the action of the stomach in vomiting would loosen the well-tied knot of a silk suture, or break the thread itself, unless the latter were very thin. If the stomach were to tear itself away from the stomach wall, the action would more probably be that the wall of the stomach were cut through at the point where the stitches were made—that, in fact, the stomach wall tore away from the stomach. This could not be prevented by the choice of this or that material, but only by the right method of sewing. Many stitches must be made close together, and each of them must contain a sufficiently wide and thick piece of the stomach wall. Fortunately the wall of the stomach is so thick that these conditions can be easily fulfilled. It is also advisable immediately after sewing up to open the stomach, and put in a drain pipe, and to leave the stomach empty so long as there is any inclination to vomit, the pull upon the stomach being always less severe when empty than when it is filled. Lastly, the stomach wall must be sewn up at a point which admits of it being drawn to the opening without the use of force. If these conditions are fulfilled, it matters little whether the fistula be placed at the cardiac or pyloric side of the stomach.

These questions of operative *technique* are partly answered *a priori*, and the experience of previous operations has in part decided them. If we desire, however, to form an opinion of the practical value of the operation, we must first of all consider the question, What is the degree of infirmity which remains as the result of the operation? With regard to this experience, only cases of patients who have become really so far convalescent that, apart from their stomach fistula, they may be considered to be restored to health, can decide.

The only case up to the present time in which such a result has been attained is that published by Verneuil.† Verneuil operated on a young man of seventeen years of age, who was nearly dying of hunger on account of a cicatrized stricture of the œsophagus, and he was enabled by nourishment, introduced through a fistula, to bring him back to his normal weight and condition of strength. In two months the weight of the body increased from 34 kilogrammes (68 lbs.) to 42 kilogrammes (84 lbs.)—that is to say, about one-fourth.

Now I can place by the side of those of Verneuil some results obtained by my fellow-student, now Professor Trendelenburg, of Rostock, which confirm and amplify Verneuil's experiences; and this is especially the case with regard to the question of lasting infirmity, in reference to which this case (which I will at once briefly report) is of much interest. The patient, a boy eight years of age, is, in my opinion, through the method by which he feeds himself without a stomach syringe, placed in a much better position than the patient operated upon by Verneuil. The following report is translated from the German:

"Henry K——, of Goldewin, near Güstrow, born on the 14th of August, 1869, drank, in July last year, by accident, a draught of sulphuric acid. About a month afterward difficulties in swallowing began to take place, on account of which the boy was placed under the treatment of Dr. Krull, of Güstrow. Every week several probings of the œsophagus were made, which were attended by good results; nevertheless the parents soon neglected to bring the boy regularly to be operated upon by the catheter, and a rapid contraction of the stricture took place. On December 18th the use of the catheter failed, and Dr. Krull sent the boy to the hospital. Here also it was found impossible to pass the stricture, which was situated in the lowest division of the œsophagus. Flexible bougies bent regularly round before the stricture, and when attempts were made with pointed instruments made of metal or fish-bone, blood made its appearance, and during the next day or two pains between the shoulder-blades with feverishness occurred, which made it appear probable that the probe had taken a wrong direction. The difficulties in swallowing were very variable. Sometimes the boy could swallow thick fluids, such as soft-boiled eggs, etc.; but generally only milk would pass, and sometimes broth and very thin soup; but not unfrequently, after attempts with the catheter had been made, everything returned. The boy was then nourished by means of Leube's clysmata.

"While, during the month of March, the condition of the boy remained so miserable, his strength fell off rapidly. The temporary complete stoppage of the stricture took place more and more frequently. After the injection of the pancreas-meat substance the sphincter ani refused to act, and the boy lay shivering and hungry in bed or sat sorrowfully huddled up by the fire. It was only with great difficulty that he was able to crawl about, supporting himself with his hands by the furniture, etc., at every step. His weight fell to thirty-three pounds, and it was evident that the wasting away had attained its maximum. Under these circumstances the consent of the father was obtained to the operation of gastrotomy, which was carried out on the 28th of March.

"The skin was cut through for a length of four to five centimeters (about two inches) in a diagonal direction, running from right to left, parallel with the underside of the cartilaginous portion of the eighth left rib, and at a distance of a finger's breadth from it. The wall of the abdomen was

divided in the same direction as far as the peritoneum, and the left rectus at the same time cut partly through. All the vessels were then carefully bound up, and, after the bleeding had entirely stopped, the peritoneum was divided in the same direction. The edge of the left lobe of the liver was then exposed to view, rising and falling with the respiration, and also a piece of intestine, which might have belonged either to the colon or to the stomach. As it could not be decided by feeling about with the introduced finger to which of these it was attached, I next pulled the diaphragm to the front, and could then easily find the junction of the same at the colon and at the stomach. The peculiar construction of the arteria and vena gastro-epiploica made the junction of the diaphragm at the stomach so characteristic that all doubt disappeared as soon as these vessels were exposed to view. The stomach had shrunk together and attached itself to the vertebral column. Its front side was now grasped at a point corresponding the best with the incision, drawn somewhat forward out of the opening, and fixed temporarily in the opening by two acupuncture needles stuck through it transversely. The two needles rested crosswise on the outer surface of the abdomen. In order that the peritoneum should with certainty be included in the sewing up, the edge of it, where cut, was grasped with pincettes and was drawn forward and secured by laying the pincettes over on one side. For the stitching moderately strong silk was used, and the stitches were so arranged that the outer skin, the wall of the abdomen, and the peritoneum were pierced, and the wall of the stomach taken up as much as possible in the entire thickness. Altogether fourteen stitches were made. After the sewing, which surrounded a piece of the stomach wall in the form of a circle about 1½ centimeter (⅝ inch) in diameter, was completed, the stomach wall was cut through within this circle crosswise and a drain pipe inserted in the stomach. The stomach was found to be perfectly empty. The whole operation was conducted under antiseptic precautions. The narcosis was extremely successful. No vomiting took place, and when the boy awoke he still remained free from any inclination to vomit, but as he then complained of severe pain, morphia was given to him. During the next few days hardly any reaction in consequence of the operation was observable. The body remained just as scaphoid-shaped and drawn-in as before. The temperature rose only once to 101·7° Fahr. (38·6° Celsius), but nausea and vomiting did not occur. After the second day, besides the nourishing clysters, small quantities of parings of meat and egg were passed, with care, direct into the stomach; and on the third and fourth days the stitches were removed. As a remarkable fact, after the operation the swallowing became somewhat easier. The boy was able again to drink milk pretty comfortably; perhaps, through the tension exerted upon the stomach, some obstructive twist in the stricture may have become straightened. Very soon, however, this improvement disappeared, and since May 12th the œsophagus has remained absolutely impenetrable.

"The boy recovered but slowly from his condition of weakness. On the sixth day after the operation a feverish catarrh of the stomach and intestine appeared, attended with diarrhea, which continued in various degrees of intensity until the middle of June. The food, consisting of meat-parings, soft-boiled egg, milk, Nestler's children's food, etc., was introduced by means of a syringe into the stomach at intervals of three hours; the meat, generally, after the boy had first masticated and salivated it, and spat it out again. When, however, this method of introducing the food was replaced by a cleaner and more natural one, the stomach catarrh disappeared. A longer tube was attached to the drain pipe, and through this the boy now lets the masticated food slide down direct into the stomach, which he assists by blowing slightly with the mouth. The boy soon learned to be quite at ease with his artificial œsophagus. By the middle of June be left his bed, and from this time forward his strength increased rapidly, so that by the middle of July the boy might be considered cured. Now he plays about the greater part of the day with the companions of his age in the open air, without experiencing any discomfort from his stomach fistula. The drain pipe is stopped with a cork, which prevents any of the juices of the stomach from escaping. A dry eczema, which at first formed round the fistula, is now healed, and the boy lives on the usual diet. His weight is at present 21 kilogrammes (42 lbs.); before the operation it was 32 lbs.; on April 26th it was 34½ lbs.; and it went on gradually increasing until July 28th, when it was 40 lbs. In the space of four months the boy had therefore increased in weight about one-fourth.

"It remains to be mentioned that an attempt to enlarge the stricture from the stomach end did not succeed. The probe easily found the entrance into the œsophagus, but could not be passed through the stricture. Possibly the œsophagus had grown together entirely at the place of the stricture.

"From the history of the patient it will be apparent that in general the directions of Verneuil have been followed. The temporary securing of the front part of the stomach wall in the incision by means of acupuncture needles stuck through crosswise, and resting flat on the outside of the abdomen, is to be recommended, also the bringing forward the cut edge of the peritoneum by means of pincettes. Verneuil says nothing about the difficulty of finding the stomach with so small an opening in the abdomen. This point, however, which is so particularly noticed by Schönborn, deserves some consideration. Lately it has again been met with by one of our own surgeons, who remained in uncertainty as to whether he was manipulating upon the colon or the stomach, and finally sewed up the colon. The diaphragm and the vena gastro-epiploica, which is seen more distinctly than the artery, will always be the safest guides to work by. I do not consider it desirable to make the fistula bigger than is absolutely necessary for the purpose of fixing a drain pipe of about $\frac{5}{16}$th of an inch. In my opinion there is not much gained for the nourishment by so large an opening as Schönborn constructed, for in the normal method of feeding through the œsophagus the food does not reach the stomach in unbroken bites, but in a state of coarse pulp, and the attempt to surpass nature in this respect cannot be conducive of very beneficial results. Apart from this a large opening has great disadvantages. It necessitates having a special apparatus for closing the entrance, where, as with a small fistula, it is only necessary to put in a suitable drain pipe and cork it up from the outside to close the stomach entirely. Verneuil found from experience that this kind of stopping was perfectly water-tight, because the somewhat swollen mucous membrane of the stomach set itself close against the drain pipe. This patient runs and jumps almost the whole day with the drain pipe in the fistula without a trace of the contents of the stomach flowing out. The neighborhood of the fistula remains dry; the eczema which at first took place is healed, and the gastric juice does not make itself perceptible even to the smell. The fistula has certainly a tendency to become gradually larger, and so to make the stopping untight, but this enlargement is purely mechanical, and can be easily corrected. It is only necessary, as soon as any slackness is observable, about every fourth or sixth day, to take out the drain pipe at night, when the patient lies on his back for a few hours; the fistula then contracts almost as quickly as a tracheal fistula when the cannula is withdrawn."

In the adjoining woodcut, taken from a sketch, the boy is represented at his meals. How he feeds scarcely requires explanation. In feeding, the œsophagus is removed to the outside, otherwise the process is as much as possible like the natural one. The boy tastes his food as before. The masticated and salivated matter remains partly in his mouth and is partly swallowed down into the œsophagus, after which he places the tube in his mouth, and sends the food, by a slight choking and spitting motion, into the tube, and lets it glide down into the stomach, assisting it by blowing slightly with the mouth. Then he shuts the pinch-cock, which he had previously opened, and recommences the process afresh. In this manner the boy is made independent of the highly unappetizing and comfortless procedure of the stomach syringe, and his feeding loses the disagreeable aspect of a physiological experiment. The gain to the boy cannot be overestimated. He who cannot take part in the friendly meal is half shut out from the society of man.

* A. Jacobi: Gastrotomy in Stricture of the Œsophagus. New York, 1874.

† Verneuil: Observation de Gastrotomie Pratiquée avec succès pour un Rétrécissement cicatriciel infranchissable de l'Œsophage (Bulletins de l'Académie de Médecine, No. 44, 1878).

A SIMPLE TEST OF THE QUALITY OF DRINKING WATER.

Nothing is more important, from a sanitary point of view, than the purity of the water used for cooking purposes or for satisfying thirst. Should it contain an undue proportion of organic matters, it might be the means of giving rise to most serious diseases, often of a fatal character. It is a very common mistake, but nevertheless a very serious one, to regard *clear* water as *pure* water; for *clear* and *clean* are not synonymous. Of course the question as to the fitness or unfitness of soil water for domestic use can only be determined absolutely by a careful chemical analysis. But since few persons wish to incur the trouble and expense of a chemical analysis, a simple method by which any one may test the quality of the water he uses may not come amiss. As is well known, the sense of taste and smell vary greatly in different individuals, one utterly failing to detect the foul condition of a water which would be very evident to a person of finer organization. Some waters, moreover, of very dangerous quality, will fail to give any indication by taste or smell. But if the causes of a bad taste or smell exist in the

water, the deleterious effects on the health will remain the same whether they are recognized or not. Heisch's test for this purpose (credited by the *Revue Industrielle* to Prof. Reynolds, of Dublin) is very useful, and so simple that any one can use it. Fill a perfectly clean pint bottle three-fourths full of the water to be tested, and dissolve therein half a teaspoonful of the purest sugar (loaf or granulated sugar will do), cork the bottle and set it in a warm place for two days. If in 24 to 48 hours the water becomes cloudy or milky, it is unfit for cooking or drinking purposes. If it remain perfectly clear it is safe to use. Cloudiness, when it occurs, is due, according to Frankland, to fungoid fermentation which takes place in the presence of sugar, and to traces of phosphoric acid occasionally met with in waters contaminated by sewage.

HYDROPHOBIA.

THE observations of Gowers and Coats on hydrophobia, that the white blood-corpuscles travel through the walls of the blood-vessels freely, together with those of Binz, that quinine arrests such movements of white corpuscles, have led to the employment of quinine in large doses, together with bromide of potassium, in at least one case of hydrophobia, with the effect that while one of the persons bitten by the same dog has died, a second who was taken ill a few days later was put under this plan of treatment, with the effect that seven days after active symptoms had set in he was not worse, but alive, and even somewhat better. It will not do for me here to allude further to what is being done by the commission to inquire into hydrophobia; but there are good grounds for believing that really valuable results will follow from the present careful examination into the maladies of animals, and those in man caused by animals.—J. MILNER TOTHERGILL, *in Phila. Med. Times.*

ESTIMATION OF MANGANESE, LEAD, COPPER, ZINC AND NICKEL, AND THEIR ALLOYS.

By A. RICHE.

THIS method, which affords a rapid means of estimation, consists in decomposing salts of the above metals with the electric current, either in acid or alkaline solution, and weighing the precipitated metal or oxide.

The apparatus consists of a platinum crucible, in which is suspended a hollow truncated cone of platinum foil with small openings in the side; in the case of manganese, however, this cone is replaced by a spiral of platinum wire. The cone or spiral serves as the negative pole, while the crucible acts as the positive. The decomposition may take place at the ordinary or at a higher or lower temperature.

Estimation of Manganese.—If a solution of the nitrate, chloride or sulphate of manganese is subjected to the action of two or three Bunsen's elements, the manganese is deposited as dioxide on the positive pole; when the decomposition is complete (which is determined by taking out a drop and treating it with ammonium sulphide) the liquid is filtered, and any dioxide that may fall on the filter paper is washed back into the crucible. The oxide, together with the crucible spiral and filter paper, is ignited, and the manganese weighed as Mn_3O_4. In the case of the sulphate no oxide is deposited on the negative pole, and consequently there is no necessity to weigh the spiral; it is therefore better to work with sulphate of manganese in presence of other metals which are deposited on the negative pole. In this way 0·0005 gramme Mn_3O_4 can easily be estimated, and 0·000 0025 gramme Mn_3O_4 detected by the rose coloration which it shows. The presence of the salts of the alkali metals and alkaline earths in no way interferes with the reaction.

In presence of excess of iron a deposit occurs on both poles, but when the current stops, the iron deposited on the negative pole dissolves as sulphate, which reduces the manganese dioxide, and redissolves it; it is therefore best, after oxidation, to precipitate the iron with barium carbonate, remove the excess of barium with sulphuric acid, evaporate the solution to dryness, dilute with water, and decompose as before. By this means manganese in blood, milk or urine may be detected and estimated.

Estimation of Lead.—In the case of lead, when an electric current is passed through a warm solution of the nitrate, the metallic lead which is sometimes deposited on the negative pole dissolves, and is redeposited on the positive pole as dioxide; but this deposit redissolves as soon as the current is stopped. To avoid this source of error, the liquid is siphoned off without any interruption in the current, the contents of the crucible dried at 105–120°, and weighed. Lead is readily estimated in presence of other metals, and may easily be separated from silver, which is deposited on the negative pole. In presence of formic and acetic acids the lead is deposited partly on the positive pole as dioxide, and partly on the negative pole as metal; oxalic acid, however, reduces it completely to metal, which is deposited on the negative pole.

Estimation of Copper.—The solution, which may contain sulphuric, nitric or hydrochloric acid, is evaporated nearly to dryness, diluted with water, and a current passed through the solution at a temperature between 60 and 90°. The copper separates out on the negative pole as a red film, which is washed, and dried at 50 and 60°. To ascertain when all the copper is precipitated, a drop of the solution is treated with potassium ferrocyanide.

Copper and Manganese.—The liquid is first subjected to the action of one element, which completely precipitates the copper on the negative pole, and partially the manganese. The manganese dioxide is washed from the copper, and the liquid containing the manganese solution is then subjected to the action of two elements, which precipitate it as dioxide.

Copper and Iron.—It is necessary in this case to keep the temperature below 70° when nitric acid is present, otherwise the iron attaches itself to the copper, which is washed free with difficulty. This is also prevented by using sulphuric acid, or by saturating the solution with ammonia gas.

Copper and Silver.—If the silver is in excess, hydrochloric acid is added, and the clear solution is then saturated with ammonia, and submitted to the action of a Bunsen's element. If the amount of silver does not exceed 0·01 gramme it may be at once precipitated by a Leclanché's element on the negative pole, the copper being left in solution. The metallic silver is weighed, dissolved in acid, and the cone replaced, when the solution is subjected to the action of a Bunsen's element; the copper is then precipitated. Copper may be estimated in the warm solution in presence of acetic acid, and therefore may be determined in commercial vinegar by this method, as follows: The vinegar is submitted directly to the action of the current, and if copper is present a black deposit appears on the negative pole; this is dissolved in nitric acid, the solution evaporated to dryness, and the residue dissolved in water; from this solution pure copper is precipitated when a current is passed through it. Copper may also be estimated in presence of phosphoric and tartaric acids by dissolving the salts in a few drops of nitric acid, and passing a current from one element through the solution.

Estimation of Zinc.—Zinc is best estimated by evaporating the solution containing nitric acid with excess of sulphuric acid, saturating the residue with ammonia, adding five grammes of ammonium sulphate, and finally acidifying with a few drops of sulphuric acid. Zinc is deposited from this solution as a very adherent bluish white film on the negative pole when submitted to electrolysis with two Bunsen's elements. The author rejects the method formerly given by himself (*Académie des Sciences*, vol. viii., 226) on account of the slowness and difficulty in working it.

Zinc and Silver.—When the solution contains less than 0·01 gramme of silver it may be separated from the zinc by subjecting the solution to a current from one Leclanché's element, when the silver is deposited on the negative pole.

Zinc and Copper.—By passing the current from one Bunsen's element through an ammoniacal or acid (sulphuric or nitric acid) solution, the copper is deposited on the negative pole. The solution containing the zinc is made acid with sulphuric acid, and a current from two elements passed, when the zinc is deposited on the negative pole.

Zinc and Iron.—In this case the iron must be precipitated with ammonia, and estimated as above.

Zinc and Manganese.—The solution is prepared as for the estimation of zinc, and a current from two Bunsen's elements passed through it, when the zinc is deposited on the negative pole; this is weighed, and the manganese which is deposited on the positive pole is estimated as described above (*Estimation of Manganese*).

Zinc and Magnesium.—The estimation of zinc is effected by adding a few drops of acid to the solution and passing the current. If the deposit contains magnesium it is dissolved in sulphuric acid, and the zinc precipitated in presence of ammonium sulphate.

Brass.—The alloy is dissolved in nitric acid, and the solution subjected to a current from one Bunsen's element, when the copper is deposited on the negative pole and the lead on the positive pole. The copper is weighed, and dissolved off the cone, which is replaced; the poles are then changed, and the lead deposited on the crucible is thus transferred to the cone and weighed as dioxide. The iron is precipitated as oxide and weighed, the solution is evaporated with sulphuric acid, and the zinc estimated as previously described (*Estimation of Zinc*).

Bronze.—Four or five grammes are dissolved in nitric acid, and the tin estimated as oxide; the copper, lead, iron and zinc are estimated in the filtered solution as in the case of brass.

Estimation of Nickel.—Nickel is deposited from a slightly acid (sulphuric acid) solution at 60 or 80° by means of a current from two Bunsen's elements. Although the nickel is generally completely precipitated the first time, it is always as well to subject it to the action of the current a second time.

Nickel and Copper.—Only the copper is deposited when an acid (sulphuric or nitric acid) solution is subjected to the action of one Bunsen's element; the solution containing the nickel is made alkaline with ammonia, and then slightly acid; on passing the current the nickel is deposited.

Nickel and Lead.—The lead is first precipitated as dioxide from a nitric acid solution by means of a Leclanché's element, and the nickel is determined afterward.

Nickel and Manganese.—The nickel is completely precipitated on the negative pole when a current is passed through an acid (sulphuric acid) solution; it is washed and weighed. The action is then continued, if necessary, until the manganese is completely precipitated as dioxide on the positive pole.

Nickel and Magnesium.—The separation is effected in a solution made acid with sulphuric acid.

The analytical results show the exactness and accuracy which attend this method.—*Ann. Chim. Phys.*

A NEW TEST FOR GLYCERIN.

By A. SENIER, M. D., and A. J. G. LOWE, Assistants in the Laboratories of the Pharmaceutical Society.

IN a previous paper (*Pharm. Journ.*, viii., 819), we have shown that when certain acid borates, as, for example, ordinary sodium biborate, are dissolved by glycerin, the glycerin does not act simply as a solvent. We found that acid was evolved, which was probably free boracic acid, and that there remained behind more basic borates, having a constitution between mono and bi-borates. Klein (*Compt. Rend.*, lxxxvi., 826) says that with acid borates mannite forms conjugated acids. He describes briefly some compounds obtained, and then says that similar reactions take place in the case of glycerin, erythrite, and certain other polyatomic alcohols. It is true that mannite, erythrite, etc., evolve acid with sodium biborate in the same manner as glycerin, but the reactions are probably not the same. The test which we are about to describe is not given by mannite, glucose, etc., although it is readily obtained from glycerin, erythrite, and apparently from glycol. We are at present investigating this reaction more fully. It is interesting, however, to note here, that while we find the action of glycerin and erythrite to differ from the action of mannite and glucose, Klein also finds the action upon polarized light different in the case of the two former, from what it is in that of the latter. The well known green color which free boracic acid imparts to flame is usually obtained in the case of borates by the use of a stronger acid, but Iles (*Chem. News*, xxxv., 204) suggests that glycerin may advantageously be substituted for the acid. This glycerin test for boracic acid involves, of course, the reaction which we have just discussed.

It occurred to us that this reaction might also be employed as a test for glycerin, but before we describe the method of applying it to that end, it will be convenient to discuss briefly its limits as regards other bodies. As might be anticipated from what we have said, monoborates do not give this reaction, at least that is the case with sodium monoborate. A considerable quantity of alkali interferes with the test, doubtless by neutralizing and fixing the acid set free. Again, a large excess of borax itself prevents the appearance of the green color in the flame. This action of a large excess of borax is interesting. Now as to the bodies which may be mistaken for glycerin. Acids give the same result to a flame as glycerin, and hence the solution to be tested must be neutral or faintly alkaline. Erythrite, and apparently glycol, also give the same green flame, but could hardly occur so as to be mistaken for glycerin. The same may be said of copper salts and certain other substances, which of themselves might impart a green color to flame. Other substances, such as sugars, fats, etc., were tried, but all failed to give this test. It appears, then, in the absence of erythrite, and probably glycol, to be a property fairly characteristic of glycerin.

The test is applied as follows: The aqueous solution to be examined is first made slightly alkaline with dilute soda-solution, and a borax bead is dipped into it. The bead is allowed to rest for a minute or so to allow solution to take place on its surface. Then it is held in the Bunsen flame in the usual way. Another method, and this we find more delicate, is to place a little powdered borax on a watch glass, and pour on to it some of the solution made faintly alkaline. Stir with a glass rod (the mixture becomes acid of course), and by means of a looped platinum wire introduce some of the mixture into the flame. In either case the deep green color appears more or less distinctly if glycerin be present in sufficient quantity.

The following experiments were made with a view of determining the extent to which the test could be applied to the detection of glycerin in various solutions. The percentages are by volume:

Glycerin in Water.—The solutions were made faintly alkaline. A 20 per cent. solution gave the color very decidedly. Solutions containing 15, 10 and 5 percentages gave the color distinctly. 2½ per cent. gave a faint color, and the limit seemed to be reached in the case of a 1 per cent. solution, which gave scarcely any color.

Glycerin in Beer.—The solutions were made faintly alkaline. 25 and 20 per cent. solutions gave the color decidedly. A 10 per cent. solution gave it distinctly, but in the case of a 5 per cent. solution it could scarcely be seen. It was evident from these experiments that, in order to detect less than 10 per cent. in beer, the solution of glycerin would have to be concentrated, and some of the foreign matter removed. To try this we prepared two solutions of glycerin, one containing 5 per cent. and the other 1 per cent. Both were treated in the same manner. 50 c.c. were evaporated to dryness over a water-bath, and the residue was treated with 50 c.c. of absolute alcohol. Solution of the glycerin in the alcohol was insured by well stirring the mixture and heating to boiling. The dish containing the mixture was then set aside to cool and subside, after which the clear alcoholic solution containing the glycerin was decanted into another dish. The solution was evaporated to dryness as before, and again exhausted with absolute alcohol. The solution from this second treatment with alcohol was evaporated nearly to dryness, and a few drops of water added. The solution thus obtained was made faintly alkaline to delicate litmus paper with dilute soda solution, and tested in the manner already described. In each case the color was distinct, of course most decided in the case of the residue from the 5 per cent. solution. A solution containing one quarter of 1 per cent. was examined in the same way, and gave the color distinctly. Beer, to which was added only one-tenth of 1 per cent. of glycerin, was examined by first concentrating and shaking with petroleum ether, to remove hop resin, and then evaporating to dryness and treating as above. In this case the green color, though less intense than before, was distinctly seen. Several experiments were made with beers to which glycerin was not added; but treating them in the way described no green color could be obtained. It was noticed that the consistence of the residues from beers to which glycerin had been added, compared with the residues of beers containing no glycerin, was very different. The former were, of course, moist and sirupy, while the latter were much harder and even brittle.

Glycerin in Wine.—To some sherry wine was added 1 per cent. of glycerin. Of this solution 50 c.c. were evaporated to dryness over a water-bath. The residue was treated, as previously described, with 25 c.c. of absolute alcohol. The alcoholic solution was then evaporated over a water-bath nearly to dryness, and a few drops of water added. This solution, made faintly alkaline and tested, gave the green flame distinctly. The same wine without glycerin gave no green color to flame.

Glycerin in Milk.—100 c. c. of milk, to which 1 per cent. of glycerin was added, were evaporated to dryness over a water-bath. The residue was treated with 50 c.c. absolute alcohol, and the alcoholic solution so obtained evaporated to dryness as before. A few drops of water were added, and the mixture filtered through a moistened filter to separate fat. The filtrate was then rendered alkaline and tested. The green color was distinctly observed. 100 c.c. of milk without glycerin similarly treated gave no green color. The fat of milk likewise gave no color reaction.

Glycerin in Treacle.—50 c.c. of treacle, in which was dissolved by aid of heat and agitation 5 per cent. of glycerin, were, while warm, well agitated with absolute alcohol. The mixture was set aside, and allowed to cool and separate. The alcoholic solution was then decanted, and evaporated over a water-bath to dryness. This residue was treated with 50 c.c. of absolute alcohol in the usual way, and the alcoholic solution so obtained evaporated over a water-bath to dryness. This second residue was treated in the same way with 25 c.c. of absolute alcohol, and the solution obtained was evaporated as before. The residue was diluted with a few drops of water, and the solution made faintly alkaline. Tested, it gave the green color distinctly. A 1 per cent. solution failed to give the reaction, thus showing at the same time that treacle itself treated in this way is incapable of producing the green color.

It may be said then of the test for glycerin here proposed that it is practically characteristic, and is delicate. It can be easily applied, and is not interfered with by the presence of a considerable quantity of foreign matter. We therefore commend it to trial by chemists as a substitute for the known tests for glycerin, which are not only few but objectionable.

In conclusion we have to express our indebtedness to Mr. H. G. Greenish for valuable assistance, and to Professor Attfield for kindly permitting these experiments to be conducted in the laboratories of the Pharmaceutical Society.

AUTHORS' NOTE.

In the discussion which followed the reading of the above paper our attention was directed to the fact investigated by Woodcock (*Jour. Chem. Soc.*, xxiv., 785), that ammoniacal

salts have the power of decomposing borax and liberating boracic acid. It was suggested that these salts might be mistaken for glycerin unless further precautions were taken. We find this to be the case.

Substances to be examined for glycerin by the test we have suggested should be first tested for ammonia, and should this be present the above methods must be so modified as to secure its complete exclusion. To determine the presence of ammonium salts, sodium carbonate, and in some cases the Nessler reagent, should be employed. The following two experiments will suggest how ammonium salts may be separated. When fats occur they must, of course, be removed prior to treatment with alkali.

50 c.c. of an aqueous solution, containing 1 per cent. each of ammonium chloride and glycerin, were evaporated in a platinum dish over a water-bath to dryness. Saturated solution of sodium carbonate was then added, and the heat of the water-bath continued until no more ammoniacal gas was evolved, and the mixture was distinctly alkaline. The mixture was then extracted with absolute alcohol, and the solution evaporated, neutralized and tested. The green color was distinctly seen.

50 c.c. of beer, containing 1 per cent. each of ammonium chloride and glycerin, were evaporated to dryness over a water bath. The ammoniacal salt was separated from the residue as before. The mixture thus obtained was treated with absolute alcohol, as described in the paper, and tested, the final solution being neutral, or only faintly alkaline. The green flame was very distinct. 50 c.c. of beer containing ammonium chloride only were examined in the same way, but gave no green color to flame.—*Journ Chem. Soc.*

PREPARATION OF METALLIC CHLORIDES.

By Charles W. Watts and Chichester A. Bell, B.A., M.B., of University College, London

The two principal processes for the preparation of chlorides in the dry way consist in (1), passing chlorine over the heated metal; and (2), passing chlorine over a mixture of the oxide with charcoal. The first is usually troublesome, on account of the difficulty attending the preparation of many of the metals; and the second, on account of the fine state of division to which it is necessary to reduce the oxide, if it is desired to obtain any considerable portion of the metal in the state of chloride. This being the case, it appeared advisable to find some more convenient process, and carbon tetrachloride seemed likely to afford a means for the preparation of metallic chlorides, and more especially of the higher chlorides.

The first experiment tried was with stannic oxide. The anhydrous oxide was placed in a long porcelain tube, connected at one end with a small retort, in which the carbon tetrachloride was kept in a state of gentle ebullition, and at the other with a cooled receiver. When the tube was heated to bright redness, and the vapor of carbon tetrachloride passed slowly over the oxide of tin, a liquid soon began to collect in the receiver, accompanied by a small quantity of a yellowish solid, either oxychloride or hydrated chloride of tin. Carbonic acid and chlorine escaped from the receiver (the chlorine being derived from the decomposition of some of the carbon tetrachloride), and a small quantity of stannous chloride was deposited in the cooler parts of the tube.

When the contents of the receiver were fractionally distilled, a small portion came over at about 80°, consisting for the most part of carbon tetrachloride, and the principal portion of the liquid distilled over at 118–120°, the boiling point of stannic chloride; it fumed strongly in the air, and united violently with water, forming a solution of stannic chloride. The product amounted to about 40 per cent. of the tetrachloride used. A small quantity of solid product was left in the distillation flask, subliming in white needles, and consisting of carbon monochloride, C_2Cl_2.

The next oxide used was titanic acid, the experiment being conducted in precisely the same way as with stannic oxide. The titanic acid was introduced into the tube in lumps about the size of buck shot. The product amounted to about 50 per cent. of the tetrachloride used; it was accompanied by a small quantity of ferric chloride. The residue in the tube consisted of unaltered titanic acid, and of skeletons of the lumps of titanic acid, consisting probably of silica. Similar experiments were tried with silica, both precipitated (from SiF_4) and well burnt black flint. The tube, about 30 inches long, was heated nearly to whiteness, but in both cases only the merest traces of silicon chloride were obtained, even with the most efficient condensing arrangement.

Tungstic acid and carbon tetrachloride gave a mixture of WCl_4O and WCl_2O_2, the principal reaction being probably expressed by the equation—

$$3WO_3 + 2CCl_4 = 2WO_2Cl_2 + WOCl_4 + 2CO_2.$$

A similar experiment with chloroform and titanic acid gave a quantity of titanic chloride, equal to about 30 per cent. of the chloroform used. A large quantity of secondary product was obtained, consisting of titanium oxychloride, chlorides of carbon, etc.; a notable proportion of the titanic chloride was also carried off by the gases, hydrochloric and carbonic acids, produced in the reaction. The formation of titanous chloride was not noticed.

Carbon tetrachloride being somewhat expensive, and a notable proportion being always lost, a mixture, in equal volumes, of carbonic oxide and chlorine was tried as a means of producing these chlorides. With titanic acid a very good result was obtained, although some quantity of the titanic chloride was carried off by the carbonic acid produced, which has double the volume produced with carbon tetrachloride: $TiO_2 + 2CO + 2Cl_2 = TiCl_4 + 2CO_2$. Silica again was hardly acted on. Tungstic acid gave a mixture of the two oxychlorides, but when a larger proportion of carbonic oxide was used, a small quantity of nearly black crystalline chloride (WCl_4 or WCl_5) was obtained. 5 grammes of tungstic acid, placed in a small porcelain tube and heated to full redness, was entirely volatilized as oxychloride after about 3 liters of gas had been passed over it. Amorphous chromic oxide was acted on with great readiness, the crystalline oxide not quite so easily; in both cases, however, an abundant production of chromic chloride resulted, which, when the tube was heated a few inches beyond the oxide, was non-deliquescent, and completely insoluble in water, showing the absence of any chromous chloride.

Red oxide of manganese, Mn_3O_4, free from iron, was acted on very easily, but the chloride being non-volatile, it could not be perfectly separated from the unaltered oxide. A very small quantity of apparently colorless crystals, containing manganese and chlorine, sublimed to the mouth of the tube at the beginning of the experiment, but the amount was too small for further examination.

A similar experiment was tried with bromine, carbonic oxide and stannic oxide. The dry carbonic oxide was bubbled through bromine kept warm in a small retort, and covered with strong sulphuric acid to prevent surface evaporation. Stannic bromide volatilized into the receiver, and some stannous bromide was left in the tube.

In all these experiments the carbonic oxide was previously prepared, and stored in a gasometer. Experiments were made in which a mixture of 1 vol. carbonic acid with 2 vols. chlorine was passed through a tube, three parts filled with carbon, and the rest with oxide, separated from one another by a plug of asbestos. Both wood-charcoal and coke were found very wasteful of chlorine, on account of the hydrogen they contain; and with gas-carbon, although carbonic acid alone was easily converted into carbonic oxide, the mixture of chlorine and carbonic acid passed through almost unchanged.

These experiments were made in the Laboratory of University College. The authors intend pursuing the subject, more especially with regard to the higher chlorides.—*Jour. Chem. Soc.*

ACTION OF CHLORINE.

By Edmund W. Davy, A.M., M.D., M.R.I.A., Professor of Forensic Medicine, Royal College of Surgeons, Ireland.

The nitroprussides or nitroferricyanides, a class of salts obtained by the action of nitric acid on the soluble ferro- or ferri-cyanides, which were first studied by Dr. Lyon Playfair, have not received the attention that might have been expected from the interesting properties possessed by those combinations; and though it is now nearly thirty years since they were first investigated, still comparatively little has been added to the facts which were ascertained respecting them by their original investigator.

Having recently been engaged in studying the action of chlorine under different circumstances on those compounds, and the facts which I have noticed in connection with this inquiry being (as far as I can learn) hitherto unobserved, and as they tend to correct an erroneous statement which has been made respecting those salts, I thought it well to bring them under the notice of this Section of the British Association.

It is stated in the different standard works on chemistry that chlorine exerts or has no action on the nitroprussides; but this I find is not the case, at least as regards many of those salts which I have made the subject of experiment; for, although chlorine does not appear under ordinary circumstances to produce any immediate action (at least on some of them), still, when its operation is long continued, it effects a very slow decomposition of such compounds. If, however, its action is assisted by the agency of sunlight, it operates much more quickly, and soon produces the complete decomposition of those salts.

This combined action of chlorine and light on the nitroprussides being hitherto unnoticed, as far as I am aware, I have made it the subject of some research, and my experiments in this direction were chiefly made on the nitroprusside of sodium, it being the best known and most easily procured of the nitroprussides.

When an aqueous solution of that salt was placed in a bottle of chlorine, and, after being well agitated with that gas, was exposed to the action of strong sunlight, it was observed soon to acquire a much deeper red color, and that a small quantity of an oil-like matter floated on its surface, either in the form of a very thin film or in minute drops. By further exposure to such light the liquid gradually lost its red color, and finally assumed a light yellow tint, while the oil-like matter increased in quantity, forming yellow globules, some of which sank to the bottom of the liquid.

The red color of the solution having thus completely disappeared, it was examined, when it was found that after saturation with an alkaline carbonate, and separation of the oxide of iron formed, an alkaline sulphide no longer gave the slightest indication of the purple reaction characteristic of the soluble nitroprussides, showing that the sodium salt had been completely decomposed. On examining further the products of this complete decomposition of the nitroprusside of sodium, I was able to detect the presence of the following substances:

The oil-like matter formed I found to possess all the properties belonging to the compounds known under the name of chlorocyanic oil ($C_6N_4Cl_{14}$), a substance which is produced when chlorine in conjunction with sunlight acts on several compounds of cyanogen; ferric chloride, chloride of sodium, and hydrochloric acid; and I should add that the chlorocyanic oil formed, by the further exposure to light, was in part resolved into what appeared to be the trichloride of carbon, some crystals of which were observed to attach themselves to the upper portion of the bottle. As to the cause of the liquid acquiring a darker red color in the early stages of its decomposition, my observations lead me to conclude that this is owing to the liberation of the nitroprussic acid, which, by the continued action of chlorine, is afterward gradually decomposed, and, when its decomposition is complete, the solution loses altogether its red appearance, retaining only the yellow tint of the ferric chloride.

The following nitroprussides, viz., those of potassium, barium, calcium, zinc, iron, manganese, and silver, were found to be decomposed similarly to that in the case of the sodium salt, when they were exposed to the combined action of chlorine and sunlight, the same ultimate products, together with chlorides of the metallic bases, being produced. And it is probable that many other nitroprussides will be similarly affected when placed under the same circumstances. The only one of those compounds which I have observed as yet that appears able to resist this combined action of light and chlorine is that of copper, which has remained apparently unaffected afte. some weeks' exposure to their influence.

From an experiment I made by passing chlorine through a solution of the nitroprusside of sodium kept at a boiling temperature, it would appear that heat, like light, aids the decomposing action of chlorine on the nitroprussides. I may further add that, according to my observations, chlorine, even without the assistance of either light or heat, will decompose more or less completely some at least of the nitroprussides; for I found that when the nitroprusside of iron was introduced into a bottle of chlorine it was almost instantly acted on, and after a few moments forms, even in the dark, a deep red solution. The manganese salt is likewise soon decomposed with the separation of the manganese as the peroxide. The nitroprusside of sodium, too, when left in contact with chlorine for a considerable time excluded from light, was found to be partially decomposed, as was shown by its giving a deep blue reaction with the ferrocyanide of potassium, indicating that the chlorine had withdrawn more or less of the iron from the compound radical of the salt.

The foregoing observations are sufficient to show that the statements which have been made and are generally received as to chlorine having no action on the nitroprussides are quite incorrect, and are contrary to the facts which I have ascertained.

There are many obvious matters connected with this inquiry still remaining to be investigated, which a number of circumstances have hitherto prevented my prosecuting, but I hope ere long to be able to do so.

METALLIC ARSENIDES.

By A. Descamps.

Some metals do not form definite compounds with arsenic, but alloys which lose arsenic on heating. The arsenides can be prepared by heating the metal with arsenic under a layer of fused boric acid, or by fusing an arsenate with potassium cyanide. Attempts to reduce the arsenates by the action of hydrogen or carbon monoxide at a high temperature did not yield satisfactory results. The arsenides of silver, gold and copper may also be obtained by immersing metallic arsenic in solutions of the salts of these metals.

Silver arsenide, AgAs, is obtained in the form of a white, brittle, very hard, crystalline metallic button, sp. gr. 8·51, when silver arsenate is gently fused with potassium cyanide. It loses arsenic on heating, forming a new compound having the sp. gr. 9·01; fused under a layer of boric acid at a higher temperature, it is converted into Ag_3As, sp. gr. 9·51.

Gold arsenide, Au_2As, is deposited in the form of a dark red powder when metallic arsenic is placed in a solution of chloride of gold. By fusion with potassium cyanide, a yellow metallic button of Au_4As_3 (sp. gr. 16·2) is obtained.

Copper arsenide, Cu_3As_2, is formed by the reduction of copper arsenate by potassium cyanide at a low temperature, or by the action of arseniureted hydrogen on copper sulphate. It is a bluish gray, crystalline, friable metallic body, having a sp. gr. of 6·94. Metallic arsenic throws down from a solution of copper sulphate a black precipitate of arsenide, but no metallic copper is formed. This arsenide becomes crystalline on fusion, and has the composition Cu_4As_3, sp. gr. 7·76.

By the direct union of copper and arsenic under a layer of boric acid, the brittle compound Cu_2As is obtained. It has a sp. gr. 7·81, and oxidizes on exposure to the air. Heated with boric acid, this arsenide loses arsenic, and forms the steel gray, brittle and crystalline compound Cu_6As.

The *arsenides of lead* readily oxidize on exposure to the air, and should therefore be preserved in water or in a hydrocarbon. PbAs (sp. gr. 9·55) is obtained by the reduction of the arsenate. Pb_2As_3, formed by the direct union of lead and arsenic, has a sp. gr. of 9·65. On heating this compound with boric acid it yields Pb_2As_4 (?Pb_4As_9) (sp. gr. 9·76), and at a higher temperature Pb_2As.

Nickel arsenide, Ni_5As_3 (sp. gr. 7·71), obtained by the reduction of the arsenate, is a brilliant, crystalline metallic body. On fusion with boric acid it is converted into Ni_3As, which can also be prepared by fusing together a mixture of potassium cyanide, arsenic and oxide of nickel.

Cadmium arsenide, Cd_2As (sp. gr. 6·26), is obtained by reducing the arsenate as a white metallic button, having a faint reddish tinge.

The *arsenides of iron* are not well defined compounds. The reduction of the arsenate yields FeAs, and the direct union of the arsenic with iron forms Fe_3As_2. These compounds are converted by heat into Fe_2As, and finally into a steel-white brittle substance containing 16–17 per cent. of arsenic.

The following arsenides were obtained by the direct union of arsenic with the respective metals, viz.:

Zinc arsenides, Zn_3As_2, form brilliant octahedral crystals, which are converted by heat into Zn_2As; *Bismuth arsenide*, Bi_2As_4, sp. gr. 8·45; *Antimony arsenide*, Sb_2As (sp. gr. 6·46), a crystalline body resembling antimony in color; and *Tin arsenide*, Sn_3As_2, a crystalline, brittle body, having a sp. gr. 6·56.—*Compt. Rend.*

Heat by Chemical Action.—By T. L. Phipson (*Compt. Rend.*, lxxxvi., 1196–1197).—If a small fragment of calcium hypochlorite be held in front of a stream of sulphureted hydrogen, the hydrogen of the latter unites so quickly with the oxygen of the former that considerable heat is evolved. The smell of the sulphureted hydrogen is replaced by that of chlorine, which is set free, and a small deposit of free sulphur takes place on the calcium hypochlorite, although the greater part of the sulphur is oxidized, forming sulphuric acid.

Atmospheric Ozone.—By A. Levy (*Compt. Rend.*).—The author's results agree with those of Daremberg. The ozone was estimated by means of potassium arsenite, and not by ozonoscopic paper, which is affected by other elements present in the atmosphere.

While papers were not colored at Paris, to the south, at Montsouris, they were colored blue, becoming decolorized again when the wind blew from the north, that is, from over Paris. The relation between the quantity of ozone and the direction of the wind appears to be governed by the law enunciated by Marié-Davy: "When the center of a storm crosses France, all the stations to the south of the trajectory show much ozone, those to the north little or none."

A relation also exists between the pressure and hygrometric state of the atmosphere, and the amount of ozone present.

Atmospheric Hydrogen Peroxide.—By E. Schöne (*Deut. Chem. Ges. Ber.*).—Dew and hoar-frost formed during the later portion of the night do not contain hydrogen peroxide. Ice contains 0·05 mgm. of hydrogen peroxide per liter. The author concludes from his numerous experiments that the quantity of hydrogen peroxide in rain, hail, dew, snow, hoar-frost, etc., increases with the distance from the earth's surface at which the condensation of the aqueous vapor takes place.

The author considers it possible that hydrogen peroxide plays an important part in nature, *e.g.*, in destroying noxious decomposing organic matter, although it occurs only in very minute quantities in the atmosphere, the maximum amount observed being 1·4 c.c. H_2O_2 per liter of air. Numerous experiments tend to show that the amount of hydrogen peroxide in the atmosphere increases with the height of the sun above the horizon, and it is also probable that the air grows richer in hydrogen peroxide as we approach the equator.

ACTION OF IODINE UPON THE OXIDES AND CARBONATES OF THE ALKALINE EARTH-METALS.

By C. F. CROSS and S. SUGIURA.

THE action of iodine in presence of oxygen upon the above compounds is interesting, inasmuch as in place of oxy-iodides, periodates of the metals are formed. Thus lime, exposed at a high temperature to the action of iodine vapor mixed with air, yields basic calcium periodate, but no iodide or oxy-iodide. Barium dioxide and barium carbonate treated in a similar way also form basic barium periodate, but no iodide. The product thus obtained dissolves completely in strong nitric acid without liberation of iodine, which, however, occurs on heating with zinc and hydrochloric acid, while on warming with hydrochloric acid chlorine is liberated. A solution giving all the reactions of periodic acid is readily obtained by decomposing the product of the action with sulphuric acid. When oxygen or atmospheric air is replaced by carbon dioxide, no formation of periodate is observed in the case of barium carbonate, while the amount produced with barium dioxide is smaller than when oxygen is present, showing that the fixation of iodine by the alkaline earths occurs only in presence of oxygen.

FORMATION OF QUARTZ.—By P. Hautefeuille (*Compt. Rend.*).—The author has previously shown that sodium tungstate is a mineralizing agent of silica, producing from it tridymite. He now shows that it will also produce quartz from amorphous silica and tridymite. For this purpose silica and fused sodium tungstate are alternately heated and cooled between the temperatures 800° and 950°. When heated, the silica combines with the soda, but on cooling it is precipitated by the tungstic acid, at first as tridymite, but below 850° as quartz. The amorphous silica disappears after several hours of alternate heating and cooling, being replaced by thin plates of tridymite, among which are very small crystals of quartz. The number and size of the latter increase considerably if the action of the fused salt be long continued.

The crystals have the density and polyhedric forms characteristic of quartz. With different methods of preparation the forms are found to be different.

ALLOYS OF ALUMINUM AND GALLIUM.—By L. De Boisbaudran (*Compt. Rend.*).—The alloy obtained when excess of aluminum is heated with gallium to a dull red heat remains quite brilliant, and does not oxidize readily during its preparation. It decomposes water at the ordinary temperature, but more readily at 40°, with formation of a brown powder, which subsequently becomes changed into white flakes of alumina; almost the whole of gallium is liberated, and appears to be free from aluminum. The slow evolution of hydrogen from the solid alloy is increased by contact with a globule of liquid gallium, an electric couple being formed.

Aluminum and gallium also form liquid and pasty alloys, which oxidize slightly in the air, but decompose water readily. The liquid alloy, when touched with a piece of solid gallium, crystallizes in a manner similar to metallic gallium, but it then no longer readily decomposes water.

METEORIC BRECCHIA, ST. CATHERINE, BRAZIL.—By S. Meunier (*Compt. Rend.*).—Of the two specimens of meteoric iron from St. Catherine, one is characterized by the presence of a considerable quantity of *millerite*, nickel sulphide mixed with pyrrhotine, while the other contains pyrrhotine only; both constitute true metallic brecchias cemented together by sulphides.

An examination of the sulphides proved so conclusively that they owed their origin to the action of sulphureted gases on the metal of the meteorite itself, that the author was induced to attempt the artificial production of a similar consolidated brecchia by imitating the supposed mode of formation of the St. Catherine specimen. Fragments of cast iron were placed in a crucible, and submitted for eight hours to the action of hydrogen sulphide at a red heat. After cooling the fragments were found to be incrusted with pyrrhotine, while many of them were cemented together by the same substance. The formation of iron sulphide was also accompanied by an elimination of carbon, which arranged itself between the metal and the sulphide exactly in the same manner as in the natural specimen, and it further resembled the latter in that it contained occluded hydrogen and gave imperfect figure markings on treatment with acids.

The success of these experiments has of course greatly strengthened the opinion which was expressed respecting the origin of the St. Catherine meteorite. Moreover, the type is very exactly represented among terrestrial rocks by certain specimens of brecchiform jasper, in the description of which the word jasper would be substituted for iron, quartz for sulphur, and calcite for graphite. These brecchias appear to have been originally fragments of jasper, which having been acted upon by thermal waters, became finally cemented together by deposited silica. Fine fissures, subsequently produced, traversing both the quartz and jasper, have been afterward incrusted by crystals of calcite, while the original interstices existing between the fragments of jasper have also been filled up by deposits of the same substance. An analogy apparently so complete between the structure of these two cosmical specimens could scarcely obtain, save by reason of similarity in their respective conditions of formation.

FORMATION OF HYDROCARBONS BY THE ACTION OF WATER.—By S. Cloez (*Compt. Rend.*).—Neither cold nor boiling water acts on spiegeleisen, but when superheated steam is passed over the alloy, heated to dull redness, hydrogen, carbon dioxide, and traces of marsh gas are produced.

By the action of dilute sulphuric acid on a ferromanganese containing iron 56·5 per cent., and manganese 38·2 per cent., and combined carbon 5·0 per cent., large quantities of paraffins and olefines are evolved; pure water, however, acts only at temperatures above 300°.

An alloy, which gave the following numbers on analysis, Mn 85·4, Fe 5·7, Si 1·2, combined carbon 3·7, graphitic carbon 4·0, was readily attacked by water yielding hydrogen, and gaseous and liquid hydrocarbons.

A similar alloy, containing 81·5 per cent. manganese, when acted on by water at 100°, yielded liquid hydrocarbons and a gas which contained hydrogen mixed with some olefines, the products being similar to those formed by the action of dilute acid on cast iron.

From these experiments it follows that when warm water is decomposed by a carbide of manganese and iron, part of the hydrogen set free is evolved as such, and the remainder combines with the carbon to form hydrocarbons, the metals being oxidized to protoxides.

GUAIACUM AS A TEST FOR COPPER.—By E. Purgotti (*Gazzetta Chimica Italiana*).—Schönbein had noticed that copper salts in presence of cyanides gave a blue color with guaiacum, and the author has since found that ferrocyanides, nitroprussides, sulphocyanates and cyanates, and also alkaline chlorides and chlorides of the alkaline earths, produce the same effect as cyanides. On this reaction he has found a test for copper. The solution, which must be free from all substances, such as ferric salts, etc., which color guaiacum blue, is mixed with a solution of an alkaline chloride and poured gently down the side of a test tube containing an alcoholic solution of guaiacum; if the most minute trace of copper is present a blue color is produced at the junction of the two liquids, and if the quantity of copper be larger the whole of the liquid becomes blue on agitation; in this way 0·001 milligramme of $CuSO_4.5H_2O$ in a decigramme of water gives a distinct coloration. The action appears to be due to oxidation by the cupric chloride—

$$2CuCl_2 + H_2O = Cu_2Cl_2 + 2HCl + O.$$

PINY TALLOW.—By G. Dal Sie (*Gazzetta Chimica Italiana*).—The two samples of this vegetable tallow examined by the author, the one obtained from Venice, the other from Trieste, differed somewhat in appearance, one being more carefully prepared than the other. The fat is obtained from a copaliferous tree, the *Vateria indica*, growing in Malabar. A careful examination, of which full details are given, showed that this substance consists of a mixture of free palmitic acid (75 per cent.), and a free oleic acid (22·8 per cent.), besides a small quantity of impurity, which may be separated by filtration of the fused mass. The presence of volatile acids or glycerin could not be detected.

The crude fat may be bleached, after filtration, by mixing it with an equal bulk of boiling water, adding 9 per cent. of nitric acid, and boiling for a few minutes. In this way the greenish color of the original substance is changed to yellow, and a subsequent exposure to the sun and air, after the acid had been removed by washing with boiling water, easily completes the bleaching process. At the same time the melting point of the fat is raised. In this form it makes good candles which give a brilliant light. The palmitic and oleic acids may also be separated by pressing in the usual way previous to bleaching. Other methods of bleaching, such as potassium dichromate, hypochlorites, etc., did not yield satisfactory results.

VARIATIONS IN INTENSITY OF CURRENTS.—Th. du Moncel.—One of the most interesting manners of demonstrating the variations in the intensity of currents transmitted through imperfect contacts is to roll upon a glass tube a coil of copper wire (No. 16) deprived of any isolating covering, and adapting to the two ends of the tube two systems of screws, with their threads arranged in such a manner that on turning and approaching each other they may compress the spiral longitudinally, and consequently effect a greater or less pressure of the turns against each other. When the pressure is very feeble the resistance of the wire of the helix is little inferior to what it would be if covered with silk, but it diminishes successively as the screws are tightened and the coils pressed against each other.

COAL DUST.—L. Simonin.—The author makes known certain facts which prove that it is in the majority of cases the heating of the coal dust diffused in the galleries of the mines to which explosions are due. Referring to the catastrophe in the Jabin Mine at Saint Etienne (February 4, 1876), he states, on the authority of the manager, that the mine in question contains very little fire-damp, and that the precautions hitherto taken with an exclusive reference to that gas are not sufficient. Others must be taken against the extremely fine coal dust, which, at the moment of the explosion of slight amounts of fire-damp, or even of blasting powder, liberates rapidly a part of the coal gas which it contains, and propagates the explosion, reproducing the cause of the evil with so much the greater energy as the current of air is more violent. Thick crusts of coke (two or three centimeters) prove this fact, and explain how it is that extensive tracts in which fire-damp has never been observed are burnt like the rest of the workings. Hence it appears that the precautions to be taken in fiery mines are complex whenever the coal dust is rich in gas and very finely divided. Explosions may, then, ensue even in mines where fire-damp is unknown. There is no need to suggest the existence of cavities full of carbonic oxide, or of gaseous hydrocarbons, and suddenly laid open by a blow from the miner's pick.

MANUFACTURE OF PLASTER.—E. Landrin.—Plasters which have served once cannot be usefully roasted again, as it has been repeatedly proved. Gypsum heated to a temperature more and more elevated loses more and more its affinity for water, but retains the property of resuming its water of crystallization. Plaster heated to redness, and mixed with water in the ordinary manner, no longer sets, but if, instead of being drenched with water, it is mixed with the smallest possible quantity of that liquid, say thirty-three per cent., it sets in ten or twelve hours, and becomes extremely hard. This fact, which has never been observed, explains the action of the elevated temperature necessary for the manufacture of English cement.

PETROLEUM SOAPS.—A. Livache.—For some time substances have been met with in trade under the name of petroleum soaps, obtained by adding to the materials commonly employed in soap making petroleum oils mixed with a certain proportion of Carnauba wax. If these products are submitted to a moderate heat all the petroleum present distills over and the soap remains unaltered. But if they are brought in contact with water, they dissolve entirely, without separation either of the petroleum or of the Carnauba wax, even as an emulsion. Yet if we attempt to dissolve petroleum, either in soap, at the moment when it forms a paste, or in soap lye, we cannot succeed; petroleum is, *per se*, absolutely insoluble in that medium. It is, therefore, to the presence of Carnauba wax, added at the moment of the manufacture of these so-called petroleum soaps, that their singular solubility must be ascribed. Carnauba wax is a complete product; in contact with alkalies it becomes saponified, and yields as characteristic product melissic alcohol, which must be considered as the true cause of the phenomenon mentioned above. Petroleum and melissic alcohol mix in all proportions, and if the mixture is brought in contact with soap lyes it dissolves at once. In like manner very small quantities of wood spirit, amylic alcohol, etc., enable ordinary soaps to dissolve as much as fifty per cent. of alcohol, the product obtained being entirely soluble in water.

MEASURING THE HEIGHT OF TREES.

SINCE so much increased interest is felt in tree planting in this country, and it has become desirable to know the height which different sorts attain in a given number of years, a few directions for quickly determining the height may not be out of place. For trees moderately tall we ascertain this approximately by placing a ten-foot pole upright against the stem. We then go to a distance from the tree, and employ the breadth of the hand as a measurer by holding it out at arm's length. The distance should be such from the tree that the breadth of the hand shall just cover the ten-foot pole. Then move the hand successively upward, thus measuring ten feet at a time, the last portions being measured by the fingers and thumbs, two feet each

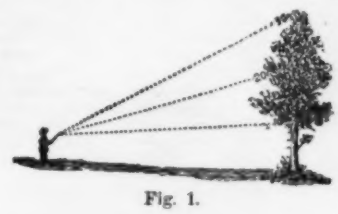


Fig. 1.

(Fig. 1). By the use of an accurate eye, and after some practice, a tree may be thus measured with a good deal of accuracy, and the result need not vary a foot from the truth if the distance of the observer is two or three times the height of the tree.

For determining the height of tall forest trees, where a few rods of open and level space could be had, we were in the practice in our young days of measuring them by the shadow in the sun's rays. The length of the shadow was determined, and a three-foot pole was then held upright, and its shadow also measured. Then, as the length of the shadow of the pole was to the height of the pole, so was the length of the shadow of the tree to its height. It was readily determined by the rule of three.

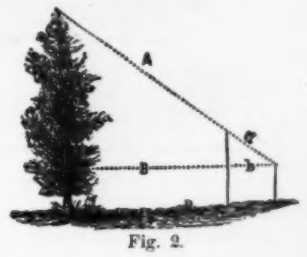


Fig. 2.

Another mode, somewhat similar in its results, may be employed on a cloudy day. Place two poles upright by thrusting their sharp ends into the ground, adjusting them with a plumb line, and the two in a line with the tree, the one nearer to the tree being twice as high as the other, and placed so far apart that the tops of the two poles and the top of the tree shall be in a line. Then, by the rule of three, as the distance of the two poles asunder is to the difference in their height, so is the distance of the observer from the tree to its height, adding the height of the shorter pole.

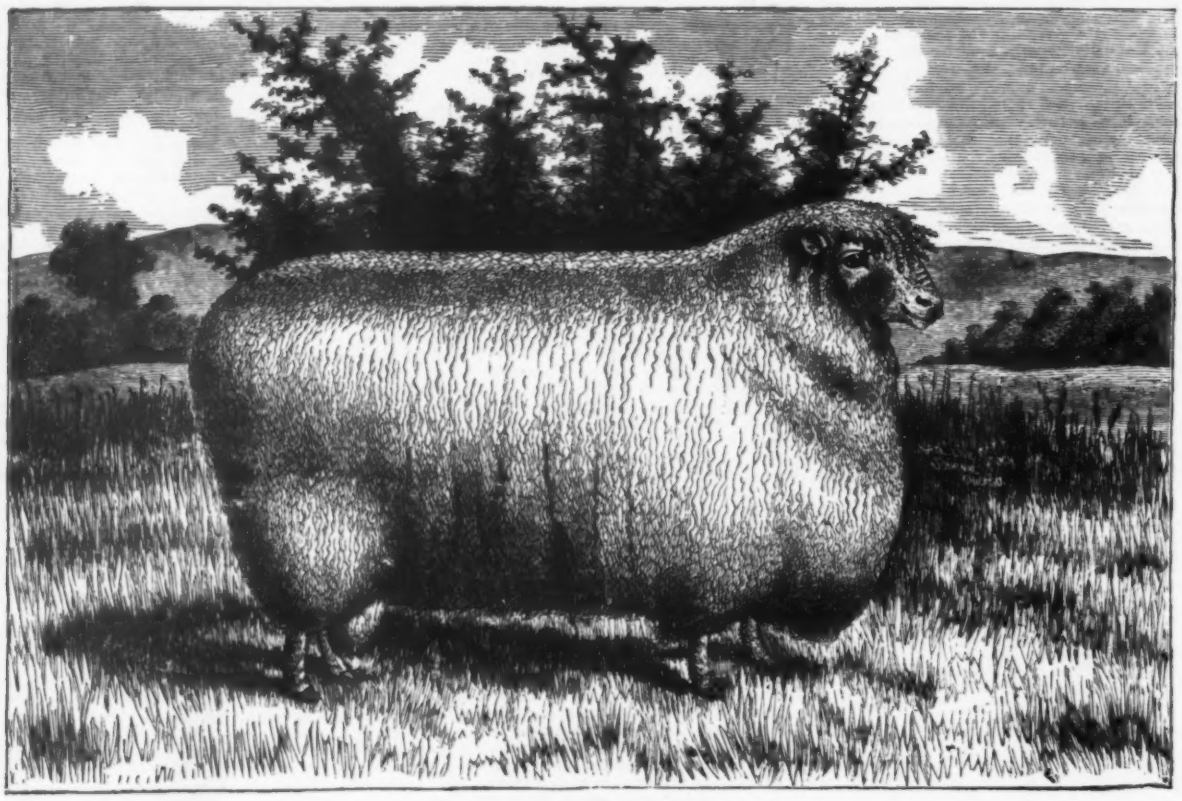
A little practice by either of these modes would prevent many of the mistakes that are made by vague guesses.—*Country Gentleman.*

THE AGRICULTURAL PRODUCTS OF CYPRUS.

OF wheat, which is one of its chief products, Cyprus raises in a good year about 1,500,000 bushels. Of these about one million bushels are consumed in the island, leaving about 500,000 bushels for export. The shipments commence in the month of June, and in 1872 the average price of wheat, placed free on board ship, was about 4s. 2d. per bushel. Barley is also cultivated to a considerable extent, but the bulk of it is consumed in the island; and in some localities small quantities of maize, oats, and millet are raised. Carobs, or locust-beans, are largely cultivated. The annual harvest of these varies from 8,000 to 12,000 tons, and the fruit is generally ready for export about the beginning of September. Its price varies from 70s. to 140s. per ton, and about three-fourths of the total export goes to Russia, Egypt taking the bulk of the remainder. Of raisins, Cyprus produces annually about 150 tons. They are of medium quality, fetch about £11 per ton, and are mostly shipped to Alexandria, Beyrout, and Constantinople. Wine is still one of the chief products of the island. About 140,000 gallons of the common red wine are produced yearly, the retail price being about 10d. a gallon Somewhere about one-third of this quantity is consumed on the island. Of the better wines, the annual product is about 18,000 gallons, and these are nearly all exported. They are bought up by speculators, who store them until matured; the price ultimately realized for Commandine, which is the kind most sought after, varying from 4s. 2d. a gallon when it is two years old, to twenty times that sum when it has been kept for twenty-five years. Brandy also is made from raisins and damaged grapes, and about 34,000 gallons are sent each year to Alexandria. Nearly 8,000 bales of cotton, of the average weight of 2 cwt. each, are exported yearly, the home consumption absorbing an additional 1,000 bales. Silk used to be an important article of export, but owing to the outbreak of a disease the production has been greatly curtailed. In good years about 220,000 gallons of olive oil, 250 to 350 tons of madder root, and 100 tons of nuts are produced. Sumac grows without particular care, and from 300 to 400 tons are yearly exported to England and Syria. In 1873 the total value of the exports from Cyprus was £360,000, and of the imports, £88,000. In 1875, according to English consular reports, the exports amounted to £384,000, and the imports to £200,000. Two-thirds of the total tonnage of ships trading with Cyprus belonged to Austria.

HEREFORDS, COTSWOLDS AND BERKSHIRES.

We recently visited the stock farm of Mr. T. L. Miller, at Beecher, in Will county, Ill., and found one of the most complete and extensive stock breeding farms in this country, stocked throughout with thoroughbred stock. Mr. Miller, being tired of city life, purchased this large farm of 1,200 acres, which he has well improved. He built a magnificent barn, and put upon it a windmill to do all his grinding, thrashing, pumping, sawing, etc. The stable underground contains 140 head of stock, the granary holds 6,000 bushels of corn, oats and other grain, and 600 tons of hay have been stored in the barn. Mr. Miller's specialties are



COTSWOLD BUCK IMPORTED BY T. L. MILLER, BEECHER, ILL.

Hereford cattle, Cotswood sheep, and Berkshire swine, all from stock imported by him.

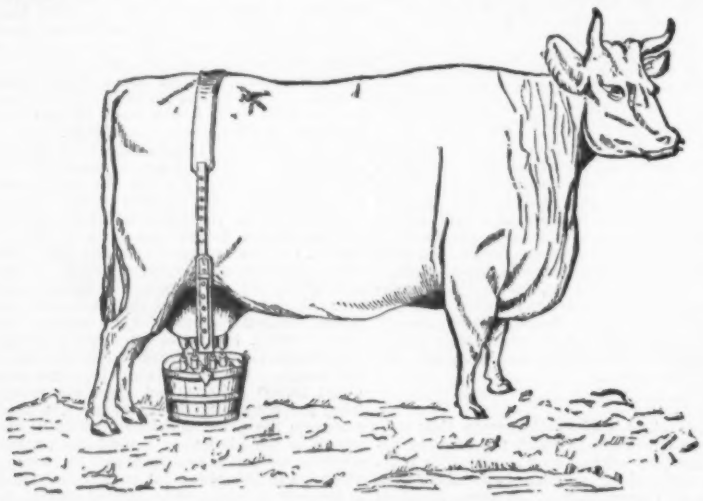
The Cotswolds.—We found in the sheep sheds and pastures about 100 Cotswolds, many of them imported from the best flocks of England, and even there it would be difficult to find a better flock. The fine engraving on this page represents the imported buck at the head of the flock. That is just the kind of Cotswold our readers want and can now get without sending to Canada or England.—*Western Agriculturist.*

COW MILKING APPARATUS.

By Wm. Blurton, of Field Hall, Eng.

Consists in introducing into the teats of cows tubes, so as to keep the milk passage open, and thus allow the milk to flow into the pail.

The tube preferred consists of a short tube perforated with small holes at the top, but open at the bottom, the lower end being inserted in a small milk vessel containing milk, so as to prevent the entrance of air into the udder when it has been drained or tapped dry. Four of these are connected together and placed in a pail, when the pail is suspended below the udder by means of a strap and buckle over the back of the cow, the object of the buckle being to tighten the strap so as to hold up the pail, and with it the tubes when once inserted into the teats. A drawing of a cow, with the milking apparatus in working position, is given. In applying the tubes, or hollow probes, the milker first takes hold of the off hind teat of the cow with his right hand, and with his left introduces the hollow tube, or probe, into the passage of the teat about an inch (and so on with the rest of the teats), when the milk will flow freely. The milk pail, or bucket, may be suspended by a sling thrown over the hind part of the cow, the hooks attached to each end of it being put through the loops of the pail, whereby it will be slung or suspended under the udder, as shown. It is advisable after introducing the hollow tubes or probes to press the upper part of the udder with both hands for a short space, say about a quarter of a minute, which will cause the milk to flow freely. One person can attend to the milking of seven or eight cows at the same time, and go on changing the apparatus from one cow to another until the milking of any number is completed.



COW MILKING MACHINE.

PEARS.

In an essay read before the Massachusetts Horticultural Society, J. W. Pierce, of West Millburg, Mass., presented some timely and valuable suggestions in relation to ripening and marketing pears. He said: A good pear may be ripened so as to be solid, juicy, and sweet, with a good rich color to its skin, or it may be made corky, insipid, and rotten at the core, or again it may be shriveled, sour, and unattractive, and these different conditions may all be obtained the same season, and from fruit grown on the same tree. While different varieties may require slightly different treatment, owing to their individual characteristics and the season, yet the same general rules will apply to all. I believe that nearly all pear growers agree that all kinds of pears should be picked while green, and ripened in the house, but at just what time they should be picked, and just how they should be handled to ripen them, are subjects on which there is much diversity of opinion.

Summer and early fall pears should be picked just before they begin to turn and when they are nearly grown, should be handled with great care to avoid bruising, and should be placed in barrels or boxes in a room or cellar where the temperature may be kept at about seventy degrees and a moderate degree of moisture maintained. After being kept in such a place a few days they will begin to turn, and some of them will mellow, then they should be sold or used before they soften. The boxes, barrels, or whatever they may be placed in should be covered with papers to exclude the light and prevent the escape of the aroma. Care should be exercised to avoid placing them so deep in barrels or heaps as to allow of the generation of much internal heat, which might carry the fermentation too high and destroy the fruit. When one has the facilities for doing so, he may improve the color and possibly the flavor by spreading them on shelves between newspapers.

This ripening between papers on shelves in a room where an even temperature and the right degree of moisture can be maintained seems to give the most satisfactory results of any method with which I am acquainted. The manner in which early pears thus treated will color is truly wonderful. It is often desirable to lengthen the season of the ripening of some of our early pears; especially is this the case where the Bartlett—which seems to be the standard summer pear for marketing purposes—is the main crop. This may be readily done by making two or more pickings from each tree, with several weeks between the first and the last picking. The largest and ripest should be picked first—as soon as the windfalls will ripen and be good—and the smaller and greener ones should be left to receive the additional sap which the earlier ones would have appropriated. Sometimes one side of a tree will be much earlier than the other, in which case the earliest side should be picked first. This early picking should be ripened off at once by the process already described, only observing that the greener the fruit the higher temperature it will require, and a more humid atmosphere will be needed to prevent their shriveling. Having ripened and disposed of this early crop, another picking should be made and served in a similar way, leaving the greenest on the trees as long as they will keep green. Mulching, and, where practicable, watering, will help to prolong their season by keeping up the vigor of the trees. Most summer and fall pears may be kept best by leaving them on the trees as long as they will hang and keep green. By making early and late pickings as described, we may obtain a larger crop from each tree and sell it at better prices, because we can put part of them into the market early, before the bulk of the crop is received, and we can keep a part of the crop until quite late and sell when the rush is over, thereby obtaining better prices.

Splendid specimens for exhibition purposes may be obtained by leaving a few of the largest and fairest specimens on the tree and picking all others early, then, when fully grown, pick and ripen between papers or blankets, as the weather and degree of ripeness they have attained on the tree may require. A great many people pick their pears too green. Such pears are small, and they will shrivel unless ripened with great care; they lack the body and flavor of those which are fully grown. Late fall and winter pears should be left on the trees until hard frosts and windy weather cause them to fall, then they should be carefully picked and packed in clean barrels, and stored where the temperature can be kept as near forty degrees as possible until the season of ripening has arrived, when they should be placed between woolen blankets in a room where an even temperature of as near seventy degrees as possible can be maintained, and they will soon ripen like summer pears.

The *summa summarum* of this whole matter is, if we wish to keep pears and retard their ripening, we must keep them in a still, dry air at a temperature as near forty degrees as possible. But when it is desirable to ripen them, put them in a dark, warm place with a moderate degree of moisture in the air, and keep them covered to exclude the light and retain the heat and gases which are generated. In warm weather use papers for a covering, and in cold weather use woolen blankets.

As an illustration of the rapidity with which sheep husbandry is advancing in Texas, "Sheep Husbandry in the South" says that in 1866 San Antonio received but 600,000 pounds of wool, which was sent through Galveston. In 1877 she received 2,000,000 pounds. The wool of Nueces and the neighboring counties is shipped from Corpus Christi. This year there will be shipped 6,500,000 pounds.